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DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

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5.

COMPRESSED AIR
MAGAZINE
EVERYTHING PNEUMATIC.

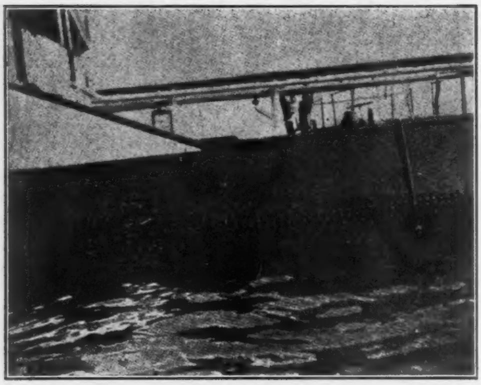
Vol. XX MAY, 1915 No. 5

KEPT AFLOAT BY THE TUG'S PUMPS.

COMPRESSED AIR SAVES ANOTHER SHIP

It is now quite well and generally known that no matter how big a hole may be stove in the bottom of a ship it can easily be kept afloat by compressed air if decks and bulkheads are approximately air tight. There comes to us through the pages of the Pacific Marine River an interesting account of the recent salving of an oil tank steamer, the Mina Brea, on the coast of Chile.

The tanker grounded on a shoal known as Lagarto Bank, about ten miles north of the northern extremity of Antofagasta Bay, while on a short trip between Tocopilla and Antofagasta. The latter port, by the way, is very close to the Tropic of Capricorn. The vessel entered the bay early in the morning with her siren going, calling for assistance. Tugs with high capacity pumps were sent off and moored alongside, and the water in the flood-



HOW LOW SHE SANK.

AS RAISED BY THE AIR.

ed compartments was kept down. Divers reported extensive damage to the bottom and after some of the lesser holes had been stopped the sailors erected an air compressor plant on the vessel's deck and she was quickly raised. Fig. 2 shows how little buoyancy there was left, the position of the deck being indicated by the line of rivets, and Fig. 3 shows how high she was raised by the air, the load of oil apparently having been discharged. Some further temporary repairs were effected on the bottom, a spare compressor was placed on board and the Mina Brea left for Talcahuano on October 23, arriving at that port on the 28th of the same month. This trip was made with a hole three and a half feet long and over two feet wide in the vessel's bottom, but the water was held back without difficulty by the air. After some repairs were effected the ship proceeded to San Francisco.

LAYING THE FLEXIBLE-JOINTED NARROWS SYPHON OF THE CATSKILL AQUEDUCT

BY STEPHEN W. SYMONS.

Among the great variety of engineering problems which have been involved in the construction of the great aqueduct which is to bring the pure water of the Catskills and distribute it in generous volume throughout Greater New York, not the least difficult and interesting is that which occurs near the end of the system, the laying of the siphon under the Narrows for the delivery of water in Staten Island.

This so-called syphon is a cast iron pipe, 36 in. in diameter, made in sections 12 ft. long, each of which weighs approximately 9,000 lbs. The total length of the syphon will be 10,000 ft. It is being laid in a trench 60 ft. deep and is covered with about 8 ft. of sand to guard against damage from the anchors of vessels. It was found necessary to flexibly couple the pipe, in order to permit of its being lowered from a lighter within a special steel lattice work, as well as to take up the inequalities of the trench. The joint employed is of the cast lead type, spherical in form, the bell end being turned on the interior, to a true sphere and highly finished with a band of steel shrunk on the outside. The spigot has deep grooves to retain the lead and a turned collar to bear in the bell. A sketch of the joint is shown in Fig. 1. It is in the caulking of this joint, after the lead has been poured, that the most interesting part of the work occurs.

Owing to the special form, it was found impractical to calk in the usual manner because of the necessity of deflecting the joint, both while laying the pipe and after it was laid, which would be almost certain to destroy the

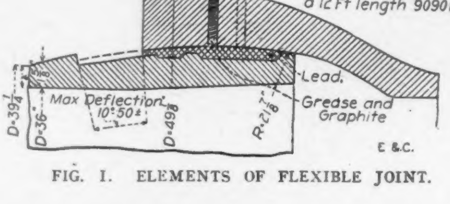


FIG. I. ELEMENTS OF FLEXIBLE JOINT.

tightness of the caulking. Caulking the pipe from the bell end, after it was in position, would also have been both expensive and difficult, as well as insecure, owing to the very strong tides to be met with in that part of the Narrows and the added cost of retaining the services of a river. The joint eventually adopted was worked out from a suggestion made by a workman who had seen lead shot forced into small joints.

As can be seen from the sectional illustration, Fig. 1, a series of 32 holes, in two rows, were drilled and tapped around the periphery of the bell end of the pipe. After the joint has been poured full of hot lead, small pellets of cold lead were introduced and forced in by means of a screw plunger, as described later, to make up for the shrinkage of the lead in cooling.

METHODS OF LAYING PIPE.

The work is being carried on by the Merrit & Chapman Derrick & Wrecking Co. starting from the foot of 79th St., South Brooklyn, and crossing the Narrows to South Staten Island. Figure 2 shows the structural steel framework carrying the pipe, in place on the lighter "Comptroller." This framework extends down to the bottom of the channel and is curved so that the pipe, on leaving it, will lie flat in the trench. A pneumatic pontoon is attached at one end to supply a certain amount of buoyancy. The framework will accommodate 12 lengths of pipe. After the work has progressed further, the position of the pipe will be changed. Instead of coming over the lighter, as shown in Fig. 2, it will come up underneath it. The operation of laying the pipe is continuous, each section being hoisted to the top of the framework and lowered into place with the spigot end in the bell end of the previous pipe. The joint is then poured, caulked and tested and the lighter with the framework warped further out into the channel ready for the next length of pipe. The lighter is held by 10 anchors, each being supplied with 1,000 to 1,200 ft. of wire rope.

POURING THE JOINT.

A removable wooden staging is erected over

FIG. 2. PIPE, CRADLE AND WORKING STAGE.

FIG. 3. SHOWING USE OF PNEUMATIC DRILLS.

the joint to accommodate the crew, melting pot and blow torch. The annular opening around the joint is first caulked with asbestos rope, held in place with a number of wooden chocks, bearing on the flange of the spigot. The arrangement of the staging can be clearly seen in Fig. 2. The discharge pipe from the melting pot is inserted in a fire clay mold at the top of the joint, everything is made fast, and the joint is ready.

The lead is heated by means of a gasoline torch operating under 80 lbs. air pressure. The lead is heated to 800° F., carefully tested for temperature and measured and the pot tapped. The total amount of lead for each joint is 350 lbs. Immediately after the joint is poured, the wooden chocks are knocked out, the melting pot is swung onto a hook conveniently placed near by, and the wooden platform removed, the whole operation taking about two hours from the time the pipe is placed in position.

CAULKING EQUIPMENT.

Pneumatic drills of the type ordinarily used for drilling metals and similar portable work, were adopted as the most reliable means for driving in the screw plugs. A saddle was rigged up of two semi-circular sections of angle iron to fit snugly over the steel band shrunk over the bell end of the pipe. This saddle carried four frames, each of which carries a drill. The drill frames allow of movement, in relation to the saddle, both longitudinaly and radially, this movement being controlled by means of a hand wheel on the dead handle of the drill for radial adjustment and, by means of a clamp and short groove, for the longitudinal adjustment. This longitudinal adjustment is necessary in order to swing the drill from one row of the holes to another. The frame holding the drill is pivoted at one end and provided with a long lever, by means of which it is fed to and from the work.

The drills used are of the angular four-cylinder type, fitted with square socket to accommodate the screw plugs. They are termed by their manufacturers, the Ingersoll-Rand Co., "No. 11 C." A system of compound gearing allows them a free spindle speed of 150 r. p. m. with great power; this being computed

as about 995 ft.-lbs. per min. The drills are controlled both forward and reverse by turning the throttle handle. The air consumption is approximately 55 cu. ft. of free air per minute, but the operations are so intermittent that it is possible to use a compressor of a little less than half the aggregate capacity of the four drills running continuously, in connection with a receiver of large capacity. The compressor is an old style Rand machine. It is rated at 98 cu. ft. of free air at 140 r. p. m. The air pressure carried while the drills are in operation, varies from 80 to 60 lbs.

OPERATION OF CAULKING.

The drill frame is clamped over the end of the pipe, which is well greased to allow of its being rotated. Two men operate each drill. The holes in the row furthest from the end of the pipe are numbered consecutively 1, 2, 3, 4, the same numbers applying to the outside row of holes. The drills are adjusted over the holes numbered 1—the word is given and No. 1 plug is withdrawn, then Nos. 2, 3 and 4. A helper hands four pellets to each drill runner who inserts them in the holes with the screw plug on top of them. When all is ready the screws are run in and run out again, beginning with No. 1 and ending with No. 4 hole; the holes are again "loaded" and the operation repeated, this time from No. 4 to No. 1 hole, and so on until four pellets have been forced into each hole. A mixture of graphite and grease is then forced into each hole, in the same manner, and permanent screws of a different type fitted with soft lead washers are run in.

The second row of holes is handled in the same manner, except that sufficient graphite mixture is forced in to insure thorough lubrication of the entire surface of the joint. A noticeable expansion of the lead from the bell end can be seen, after the first row of plugs has been driven in. The methods of handling the drills can be seen in Fig. 3.

Driving the pellets into the row of holes farthest from the bell end first forces the lead to expand towards the bell end and further insures a thoroughly tight joint. Each pellet measures 9/16 in. x 1¾ ins. and weighs about 3 ozs., a total of 128 pellets, or approximately 24 lbs., being driven into each joint. The pressure within the joint is estimated at 22,000 lbs. The whole operation takes about half an

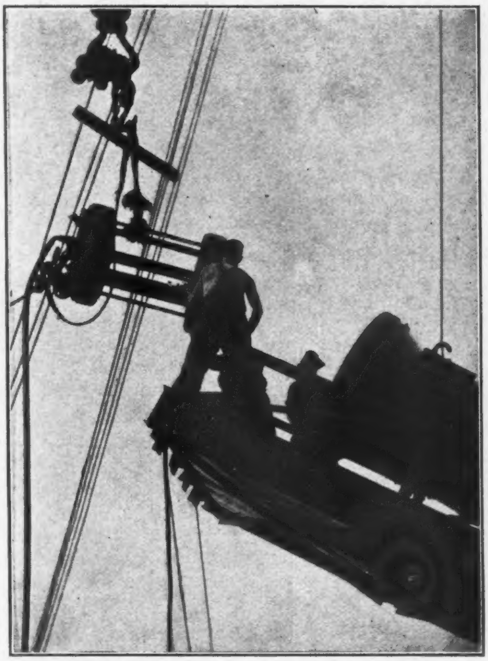


FIG. 4. APPARATUS FOR TESTING JOINT.

hour, though the actual time for driving one set of four pellets and running the plugs out again averaged 30 seconds.

TESTING THE JOINT.

The joint is tested under the most severe conditions. The joint is first deflected to 5°, the maximum it is designed for being 10°. A testing machine is then lowered into place. This, as can be seen in Fig. 4, is composed of two diaphragms, held together by tie rods and provided with rubber cup leathers. One diaphragm is adjusted on each side of the joint and water under 100 lbs. pressure is introduced. No leakage has been recorded up to the time of the writer's visit, testifying to the thoroughness of the work and the practicability of this type of joint. The joint showed a smooth, well-greased surface where it was deflected. The total number of sections will amount to about 840. They are being laid at the rate of four a day, so that it will take the better part of a year to complete the work.

The contractors, the Merritt & Chapman Derrick & Wrecking Co., are handling this work in a highly efficient manner, as can be judged by the performance set forth in the foregoing

EXPLOSIVES—LOW, HIGH, SMOKELESS

An explosive may be defined as a solid body which under the influence of heat, or shock, resolves itself instantaneously into gaseous matter. Both chemical and physical forces come into play in this transformation. The solid constituents of the explosive mixture, on ignition or detonation, undergo chemical changes and become gaseous in character. The gas produced then expands under the influence of the great heat liberated by the chemical reaction, and requires many hundred times the volume, or space, taken up by the original solid matter from which it was generated. The completeness of this change determines the value of the explosive for military or other purposes.

Explosives may be divided into two classes known as "low" explosives and "high" explosives. In the "low" explosive the combustion is started by simple ignition, and spreads throughout the mass by the transfer of heat from layer to layer. The physical form of the explosive and the pressure, determine the rate at which the decomposition proceeds. The more finely divided the grains of powder, the more rapid is the combustion, and the art of preparing explosives for rifle- and gun-fire consists in adapting the grades of powder to the work required. Black powder and the allied smokeless powders are low explosives.

"High" explosives require to be "detonated," and for this purpose a cartridge of mercury fulminate is generally employed. The decomposition of the explosive after detonation proceeds exceedingly rapidly in the form of an explosion wave. The explosives containing guncotton, nitro-glycerine, and nitrate of ammonia, are included in this class.

The original "black" powder, which may be regarded as the progenitor of all the later forms of explosive, consisted of charcoal, sulphur, and nitrate of potash. On firing this mixture, the nitrate of potash provided the oxygen necessary to convert the charcoal and sulphur into gaseous form, the nitrogen escaped free or in the form of an oxide, and only a slight deposit of potassium sulphide and sulphate remained behind to mark the place where the heap of black powder was ignited. The ordinary black powder contained 75 per cent. potassium nitrate, 15 per cent. charcoal, and 10 per cent. sulphur. Until a few years ago there were very slight differences to be found in the composition of the black powder used by the nations of Europe for military purposes; in fact, only slight changes had taken place in its composition or method of manufacture since it was first made by Bacon in the thirteenth century.

About forty years ago, the introduction of larger guns made it desirable to use an explosive that would be slower in its action, exercise less sudden pressure on the chamber of the gun, and continue the driving power up to the moment when the projectile left the muzzle. The "brown prismatic" powder was developed about this date, and gave much better results than the black powder previously employed for these large guns. The changed conditions governing the ignition of the charge were attained by using partially charred wood in place of charcoal, omitting the sulphur, and compressing the mixture before issue into large, dense prisms which ignited more slowly than a powder.

Both the brown and black powders, however, produced smoke, and the next step in advance was to invent a powder that, when fired, should be smokeless, and would not reveal the position of the gun. Vicille, a Frenchman, in 1884, succeeded in producing the first really smokeless powder from gelatinized nitro-cellulose, or "guncotton." This powder was introduced and known in the French Service as "Poudre B." Guncotton is made from cotton-waste, or cotton-wool, by treating it with a mixture of nitric and sulphuric acids. It is what chemists term a "substitution" product, that is, three atoms of hydrogen in cellulose are replaced by three groups of atoms, forming the NO_2 molecule. The chemical name for guncotton is, therefore, tri-nitro-cellulose, and its chemical constitution is represented by the formula, $C_{12}H_{14}O_{10}(ONO_2)_6$. Its advantages compared with ordinary black or brown gunpowder are: A greater explosive force, weight for weight; the products of combustion are entirely gaseous, therefore cannot foul the gun; it is non-explosive when wet, and can be safely transported and stored in this state; and, finally, it is smokeless or nearly so.

The British War-Office Chemist, Abel, made many improvements in the manufacture of tri-nitro-cellulose, and Nobel, by dissolving

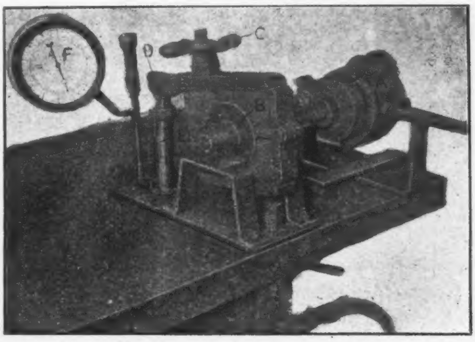
guncotton in nitro-glycerine, was the first to produce a hard horn-like material, which proved a safe form to handle.

"Cordite" is the form in which guncotton is employed for military and naval purposes in the United Kingdom, this name being due to its cord-like appearance in manufacture. Cordite is composed of nitro-glycerine, nitro-cellulose, and a mineral jelly. The effect of the two latter, when employed in conjunction with acetone, is to convert guncotton into a plastic substance that can be squeezed or rolled into any form desired, and that becomes hard and horn-like when dried. It can be cut into lengths, and handled or stored with perfect safety. When ignited it gives out great power, and exerts a uniform pressure in the chamber of the gun. Great accuracy has been attained in its manufacture, and its power can be modified to suit the requirements of the gun in which it is to be fired. For rifle fire the maximum pressure allowed is 20 tons per square inch,—for larger guns 19 tons per square inch.

Another group of new explosives have phenol (carbolic acid) as their base, and are known as "picric-acid" explosives. They are obtained from the action of nitric acid upon phenol, and by substituting, as in the manufacture of guncotton, the NO_2 group up atoms for the hydrogen atoms of the original compound. "Melinite" and "lyddite" are well known forms of picric-acid explosive used by the French and British military authorities.

The latest form of explosive for filling shells and torpedoes is, however, one of which toluol is the base, toluol being a methyl derivative of benzol. By the action of nitric acid upon toluol, substitution products containing three or four NO_2 groups can be obtained. It is now recognized that tri-nitro-toluol and tera-nitro-toluol are the best explosives for shells and torpedoes, since they do not act on the metal of the container like picric-acid explosives, and are quite stable under all conditions. All the countries involved in the present war are, therefore, using the nitro-toluol explosives in large quantities, and the demand for toluol, which is a derivative from tar, and, therefore, a by-product of coal distillation, is likely to be very keen as long as the war lasts.

"Tetra-nitro-aniline," another nitro-substitution product, derived from aniline, possesses most powerful explosive properties, and is doubtless now being employed by the Germans; while "ammonal," an explosive containing ammonium nitrate, aluminum powder and tri-nitro-toluol, has been employed by the Austrians in shells. "Turpenite" is another new explosive reported to have most deadly effects upon all forms of life. The composition of this explosive is not known, but, as it emits poisonous fumes, it is probable that cyanides (prussic acid is a cyanogen compound) enter into its composition. Turpenite has been tried experimentally by the French, but it was discontinued because its poisonous effects upon the air and soil are too deadly and too persistent. *J. B. C. Kershaw, in Engineering Magazine.*



MEASURING POWER OF AIR MOTOR.

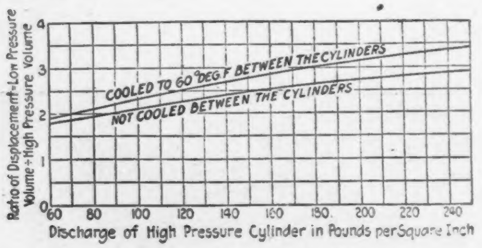
A PRONY BRAKE FOR TESTING AIR MOTORS

The halftone above shows a prony brake device in use in the C., R. T. & P. R. R. shop, Silvis, Ill., for testing air motors and described in the American Machinist by E. A. Thanton, Cincinnati. A is the motor being tested. It is coupled to the disk B which is clasped by the brake. The air is turned on and the brake blocks are tightened on the disk by turning the star-wheel C. The end of lever D rests on the plunger in the oil cylinder E, the pressure exerted on the oil is indicated by the gage F, and from the reading of the gage the torque of the motor and the actual power exerted are easily computed by the use of a constant multiplier in combination with the speed of rotation. With the evidence afforded by this device there can be no question as to the working condition of the tool to which it is applied.

CYLINDER RATIOS FOR AIR COMPRESSORS

BY F. W. SALMON.

Many steam-driven air compressors have to operate at speeds differing greatly from hour to hour to suit the demands for air. This makes it desirable to choose the cylinder ratios of the two-stage air ends with great care, so that the machine may operate steadily and smoothly without danger of stopping on a dead center even at the lowest speed, for naturally, a two-stage compressor will be chosen in most cases to secure economy in power for pressures of 80 lb. or higher, and in the case of large compressors, often for lower pressures.



The curves show the volumetric ratios required for a two-stage air compressor taking dry air at atmospheric pressure at sea level and delivering it from the high-pressure air cylinder at pressures of 60 to 250 lb. gage, both cooled and not cooled between the cylinders. Moreover, they are calculated to give the same power in the high-pressure cylinder as in the low-pressure.

In various books on compressed air, such as that by Frank Richards, Kent's "Mechanical Engineers' Pocket-Book," and Suplee's "Mechanical Engineers' Reference Book," are given tables showing the horsepower required (neglecting friction) to compress and deliver one cubic foot of free dry air per minute at atmospheric pressure, to given discharge pressures, both isothermally (perfectly cooled between the cylinders and during the compression) and adiabatically (not cooled at all). This given horse-power has been divided equally between the two cylinders and the mean effective pressures calculated for each, as well as the resulting intercooler pressure, which may be taken as the initial pressure for the high-pressure cylinder. Hence the volumetric displacement to meet these conditions could be readily calculated for several of the pressures given, including the 60-lb. and the 250-lb., and a smooth curve drawn through the points so obtained on the chart. This covers the range of pressures needed in over 95 per cent. of the air compressors sold, and it can be read close enough for all ordinary work, because in commercial practice air compressors are rarely made to bores of fractions of an inch.

Practically all air compressors operate between the limits shown by the two curves. Even in a single-stage compressor the air is cooled somewhat during compression, and yet in the best two-stage machine it is never quite as perfect as isothermal compression; hence in practice it is wise to choose the nearest commercial cylinder sizes that fall between the curves shown in the chart. Of course, one should consider the actual volume of air displaced from each cylinder rather than the piston displacement, as the cylinder ratio depends upon the volumetric efficiency of each cylinder, which is rarely the same for both the high- and the low-pressure cylinders. This is illustrated in the following example:

Assume, that in order to deliver the air required, a 24-in. low-pressure cylinder will be used having a 30-in. stroke and giving a volumetric efficiency of 0.90 for this stroke with the type of valves used. The size of the high-pressure cylinder is desired that will discharge air at 100 lb. gage, with the same stroke, but with a different type of valve which will probably give a volumetric efficiency of 0.85.

Running up the 100-lb. line the best cylinder ratios are found to be 2.11 not cooled or 2.30 cooled. As both cylinders are to have the same stroke, only the areas have to be considered; hence, if A represents the area of the low-pressure piston in square inches and a the area of the high-pressure piston in square inches, then,

$$a = \frac{A \times 0.90}{constant \times 0.85}$$

or

$$a = \frac{452.4 \times 0.90}{2.30 \times 0.85} = 208 \textit{ sq. in.};$$

say 16¼ in. diameter (if fully cooled), and

$$a = \frac{452.4 \times 0.90}{2.11 \times 0.85} = 227 \textit{ sq. in.};$$

say 17 in. diameter (if not cooled).

Thus, there is not much difference, and as

explained above, actual practice will lie between these two curves.

[The above article, reprinted from the pages of *Power*, our readers may take for what it may be worth. Why there should be any computations having to do with two-stage compression without intercooling is not quite obvious, since to provide the opportunity for the intercooling is the only practical reason for the two-stage arrangements. ED. C. A. M.].

BREAKING ROCK FOR STEAM SHOVELS.

BREAKING UP ROCK FOR STEAM SHOVELS

BY CHARLES C. PHELPS.

When a steam shovel encounters chunks of very soft rock that are too large to enter the bucket, the simplest means of disposing of them is often by sledging and sometimes by dropping them upon another rock. If the rock is of harder nature, however, blasting must be resorted to. In rock excavation work, the material may be shattered to such an extent that all subsequent breaking will be unnecessary if the blast holes are spaced sufficiently close and if relatively heavy charges of explosives are employed. This procedure will, however, so greatly increase the cost of operations as usually to make it prohibitive. The plan generally adopted, therefore, is to drill so that the bulk of the material will enter the jaws of the bucket and then employ a gang of men to go ahead of the steam shovel and break up all the rock that is oversize.

Generally speaking, there are two ways of blasting such boulders, i. e., by applying surface blasts to the rock and by exploding charges in shallow holes drilled in the rock, the latter being known as pop-shooting or block-holing. In surface blasting, a stick of dynamite is placed against the rock and, after being properly wired up, it is covered with a "mud-cap," "plaster," or "dobie" of mud or mortar. Naturally the breaking effect by this method is much less than with a charge in the body of the boulder, and the cost of powder for blasting a rock of any size in this way is very much more than for pop-shooting.

Four ways of accomplishing block-hole drilling are open to the contractor or quarryman, namely: (1) With sledges and hand steels; (2) With mounted tripod drills; (3) With non-rotating plug drills operating with compressed air, and (4) With steam or air operated hand drills of the self-rotating type.

The last type operates satisfactorily on

steam as well as on compressed air. Formerly plug drills were not constructed to employ any other power than compressed air, therefore the development of the steam type has greatly broadened the field of the hand drill, one of the most important applications being its use as an adjunct to a steam shovel.

In order to compare the relative advantages of the four methods, we will consider an average case where the rock is a very hard limestone and where it is necessary to drill pop-holes averaging 12 ins. in depth. The holes put in by tripod drills would probably be a little over 2 ins. in diameter and those made by the first, third and fourth methods would probably be under 2 ins. in diameter, but this difference can be left out of consideration because the smaller holes would be amply large for their purpose. The cost of sharpening steels can also be left out of consideration, for this would be nearly the same per foot of hole in all four cases. The wages for drill operators range from $1.50 to $4 per shift in various parts of the country and from $1.50 to $3 per shift for helpers. We will therefore use in our calculations the average wage of $2.75 for drill runners and $2.25 for helpers per eight-hour shift.

A medium size piston drill will require about 125 cu. ft. of free air per minute at 90 lbs. pressure, or if operating on steam will require about eight boiler horsepower at a corresponding pressure. Both of the small types of hand drills will require less than half of this amount of power. In the most advanced type of oil-engine driven air compressor, air can be compressed to this pressure for a fuel cost of about 4 cts. per 1,000 cu. ft., with kerosene at 8 cts. per gallon. The cost of steam at this pressure would be about 9/10 cts. per boiler horsepower per hour with coal at about $3 per ton, assuming 6 lbs. of coal required per hour per boiler horsepower.

The cutting speeds referred to below are only approximate, being based on a large number of actual cases that have come to the attention of the writer. The cutting speed of five minutes per foot has been applied to cases two, three and four to be on the safe side in estimating, although a slightly better speed should be attained in case three and a still greater speed should result in case four, for reasons to be explained later.

DRILLING WITH SLEDGE AND STEEL.

Labor cast per shift, 1 drill man	$2.75
Labor cost per shift, 2 sledge men	4.50
Total	$7.25
Time required to cut 12-in. hole, about, minutes	15.0
Cost per 12-in. hole	$0.227

DRILLING WITH MOUNTED PISTON DRILLS.

Labor cost per shift, 1 driller	$2.75
Labor cost per shift, 1 helper	2.25
Total	$5.00
Cost for steam (assuming drill in actual operation during 2/5 of shift)	0.23
Cost for labor and steam per shift	$5.23
Cost for air (assuming drill in actual operation during 2/5 of shift)	$0.96
Time required to cut 12-in. hole, about, minutes	5.0
Time required to move drill from previous setting and to adjust (5 to 10 minutes), average, minutes	7.5
Total per hole, minutes	12.5
Labor and steam cost per 12-in. hole	$0.136

DRILLING WITH ORDINARY PLUG DRILLS.

Labor cost per shift, 1 driller	$2.75
Cost for air (assuming drill in actual operation during 5/6 of shift and air consumption ½ of mounted drills)	1.00
Cost for labor and air per shift	$3.75
Time required to cut 12-in. hole, about, minutes	5.0
Time required to shift and for small delays, minutes	1.0
Total per hole, minutes	6.0
Labor and air cost per 12-in. hole	$0.047

DRILLING WITH AUTOMATICALLY ROTATED HAND HAMMER DRILLS.

Labor cost per shift, 1 driller	$2 75
Cost for steam (assuming drill in actual operation 10/11 of shift and steam consumption ½ of mounted drills)	0.26
Cost for labor and stean per shift	$3.01
Time required to cut 12-in. hole, about, minutes	5.0
Time required to shift position, minutes	0.5
Total per hole, minutes	5.5
Labor and steam cost per 12-in. hole	$0.035

Comparing the accompanying estimates of cost, it appears that drilling with sledge and steel is extravagantly expensive. Drilling with mounted drills is also very expensive for this class of work, due mainly to the fact that more time is consumed in setting up the drill than in actual cutting. The choice of equipment would, therefore, seem to lie between the two types of hand drills. The difference in cost of operation between the two latter types does not appear to be so great from the above estimate, but there are other considerations of equal importance which point to the automatically rotated hand hammer drill as the ideal type for steam shovel work. In the first place it operates on steam taken directly from the boiler of the steam shovel, whereas the ordinary plug drill is adapted for operation on air only. This eliminates the initial and upkeep cost of a compressor mounted on the

steam shovel boiler or a separate compressing plant and any charges that there might be for attendance to such a unit. This one consideration has been the determining factor in a large number of cases where the automatically rotated hand type has been adopted for drilling pop-holes in connection with steam shovel excavation. Another important advantage of the latter type is the fact that the hole is quickly started and the steel is scarcely ever known to stick due to the positive rotation mechanism. On the contrary, ordinary plug drills frequently cause trouble and delay in these respects, especially when they are operated by inexperienced workmen, and the amount of muscular energy required to rotate a plug drill back and forth soon tires the operator, so that he is incapable of keeping up to the pace which we have adopted as our standard.

The drill in the halftone has an 18-in. piece of ¾-in. pipe screwed into the exhaust to carry the steam away from the operator, and wooden handles are fitted to the machine, so the drill is perfectly comfortable to handle. In this case there is a 60-ft. length of hose and the boiler pressure gage registers about 110 lbs. In other cases the drill operates as far as 400 or 500 ft. away from the shovel. In such cases poorer results are to be expected, especially in cold weather, due to the condensation of the steam in the line, even when it is covered with insulating material. The steam operated drill may be used for cutting either wet or dry holes. In the latter case hollow drill steel is often employed, together with a special type of throttle valve on the exhaust which can direct the steam through the steel at the will of the operator to blow the cuttings out of the bottom of the hole. It is customary to use a slightly smaller piston with a drill operating on steam in order to allow for the expansion. Likewise only the best quality of steam hose should be used for conveying the steam to the drill. Proper lubrication is of even greater importance when operating with steam than when using air and a heavier oil should be used with a steam drill than with one using air. It will pay to remove the steel from the chuck occasionally and squirt a few drops of oil on the bottom of the piston. This, in addition to the regular automatic lubrication, will result in a drill of this type operating practically as well with steam as with air.

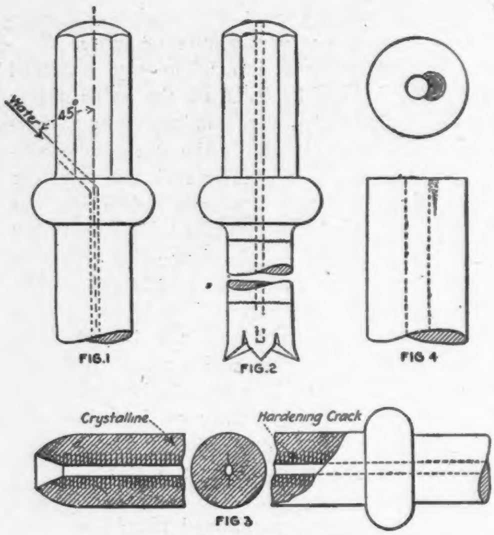
These little machines use the hammer principle and operate at a very high speed, perhaps 1,000 blows per minute or more.

An interesting and puzzling case occurred recently in which drills of the self-rotating hand hammer type were condemned by a quarry superintendent because the steels were constantly getting stuck. The rock was a rather soft limestone and a six-point drill bit was used. The drill was examined for defects but none were found. Then four-point bits were substituted and that helped matters a little, but the trouble continued. The bits were then removed and flattened on the bottom until they were quite blunt, which resulted in ending the difficulty. The trouble had been due to the pointed bits cutting so fast that they would soon become embedded in the cuttings, preventing the rotation of the steel and, of course, interfering with the action of the piston. This case is mentioned simply to show that, in applying this novel type of drill, difficulties may be encountered under unusual conditions, but the exercise of a little ingenuity in adapting the machine to the conditions will generally overcome them easily.

The new type has become popular with the drill runners, because they are so much easier to handle. In many cases their adoption has resulted in increased earnings for the men. In one notable instance, where hundreds are in operation, the drill runners are earning nearly 20 per cent. more in wages while the profits of the owners are increasing correspondingly due to increased production and lower operating costs.

DEEPER DRILLING GETS THE GAS

By drilling abandoned gas wells deeper the Wyckoff Oil and Gas Co. has struck a number of paying gas wells near Kane, Pa. Three wells, one registering 5,000,000 feet, another registering 1,500,000 feet and the third registering 1,000,000 feet have been harvested by the company quite recently. During the last year a number of wells were drilled to a depth of 1,600 feet without success. These wells were leased by the Wyckoff company and drilled to a depth of 2,600 feet with wonderful results. As a result of this successful venture other companies are taking up leases. The field was regarded as a failure a year ago, when 60 gas wells were drilled with unyielding results.



DRILL STEEL EXAMPLES.

FAILURE AND HEAT TREATMENT OF DRILL STEEL

BY SVEN V. BERGH.

The development of the hammer-drill machine during the past decade has brought with it high requirements for the drill steel. As a consequence, the steel has from time to time been much improved. However, to use to the best advantage the steel at present on the market, it should be selected with regard to the work to be done, and the right treatment should be applied when the steel bars are made into drills.

The steel generally used for rock drilling may be classified as carbon steel; hence the degree of hardness means the percentage of carbon contained. Experience has proved that the proper percentage of carbon is governed chiefly by the hardness of the rock to be drilled and by the power of the machine. E. Odelberg says in *Jernkontorets Annaler*, 1912, that he seldom found among mining men a right understanding of the fact that the harder the rock, the softer must be the steel. This is due to the fact that the bit will not stand the impact if too hard a steel is used to penetrate hard ground, the degree of hardening necessary to improve the wearing qualities of the bit depending upon the conditions under which it has to be used. The above rule must also be applied when a heavier type of drill is being substituted for a lighter one and the steel does not seem to stand up well. The ultimate carbon hardness being already reached, a softer steel must be tried.

In some drilling practice, as, for instance, when hand-feed drills are used, bending stresses are likely to be put on the steel. Additional tensile and compressive stresses are thus induced during the period of the blow, producing an excessive strain in the steel. In such practice a heavy size of steel is to be recommended.

When the steel is shanked it is of importance to give the shank sufficient length and cross-sectional area. It happens not infrequently in mining fields, where a light type of drill has been substituted for a heavier one, that the old steel is continued in use. This is not advisable, for the additional reason that it necessitates a considerable change in the front head of the machine. The inconvenience of such a practice is shown by tests in the following table taken from my article in the *Journal*, September 26, 1914, p. 560.

EFFECTS OF NEW AND OLD CHUCK BUSHINGS ON DRILLING SPEEDS OF INGERSOLL M. C. 32 DRILL.

Air Pressure Gage, Lb. per Sq. In.	Net Time of Run, Minutes	Depth Drilled, Inches	Front Head Bushing
78	3	14.6	New
78	3	12.2	Old

The number of ruptures may sometimes be greatly reduced by giving the shank a greater cross-sectional area. In 1911, tests were carried out at a mine in Sweden to find the effect of such a change. The rock at this particular mine is exceedingly hard to drill, as it consists of quartz-striped magnetite and hematite ore with leptite as a country rock. During a three-month period one and the same type of drill was used. The following results were obtained: Ordinary shanks ruptured, 185, corresponding to 6277 m. drilled; strengthened shanks ruptured, four (171 used in all), corresponding to 700 m. drilled. These figures show a considerable improvement following the use of the heavier shanks. Here it may also be mentioned that all abrupt changes in section and sharp corners should be strictly avoided.

So far as water-using drills are concerned, when the water is fed into the steel through a radial boring it has proved an advantage to drill the hole at an angle of 45° with the center hole of the steel, Fig. 1.

To shape the shank and the bit, the steel has to be upset at both ends. This operation changes the internal structure of the steel unfavorably, at the same time producing in some parts of it the bad effect of "cold work," due to the manner of applying the heat. Ruptures as shown in Fig. 2 are frequently seen. Thus to utilize the best properties of the steel it is necessary that the upsetting be performed in such a way that the steel receives the proper heat treatment. From this it may be understood why it is regarded good practice to forge and harden the bit in separate heats.

To obtain the finest grain, the bit has to be forged continuously from the highest temperature employed down to the finishing temperature, which probably is slightly above the point of recalescence. It is advantageous in hardening not to treat it to any higher temperature than necessary. The steel is liable, if heated too high, to change into a coarse crystallization and develop hardening cracks that may cause ruptures.

The shank must always be tempered properly after being hardened. Some good hints on this point are found in an article entitled "Hammerdrill Shanks," COMPRESSED AIR MAGAZINE, October, 1914.

Finally, it may be mentioned that shanks sometimes rupture longitudinally, Fig. 3. Some cases that were investigated showed that the failure was due to careless straightening after the steel had been upset. The center hole of the shank was thus oval instead of round and this later caused it to rupture when the steel was used.

Two kinds of rupture may be distinguished, namely: (1) ruptures that appear as developed from a coarse-grained structure and (2) ruptures that evidently have developed from a partial break or inclosure in the steel. In regard to ruptures of the first class mentioned, the opinion frequently heard among users of drill steel is that the crystalline texture often found is due to vibrations. It is not my intention here to discuss whether such an opinion is wrong or not, but to call attention to the fact that the crystalline texture might have been caused during the manufacture of the steel bars by wrong or insufficient heat treatment. The crystallized steel is sometimes hard to restore completely. By annealing, the crystals may only be more or less broken up, still maintaining their previous orientation. Thus cleavage planes are developed along which ruptures occur, giving the appearance of a crystalline fracture, although the steel in reality is fine-grained.

The typical fracture of the second class is as follows: A circular or oblong cavity or a crack is found at some part of a transverse section. This cavity or crack is surrounded by concentric rings covering a certain portion of the section, the rest being more or less covered by an ordinary crystalline fracture, Fig. 4. Mr. Catlin, of Franklin Furnace, called attention to ruptures of this kind at a meeting of the New York section of the Mining and Metallurgical Society of America, in January, 1914. He stated that according to his experience these inclosures seemed to run through the whole length of the steel and if it was broken anywhere, one could expect to find them. I am also able to state from my own investigations that this kind of rupture occurs rather often.

Similar ruptures are often found in connection with broken rails. Two interesting articles recently published upon this subject are to be found, one in *Iron Age,* Feb. 19, 1914, and one in the *Railway Age Gazette,* Feb. 6, 1914.

It is of practical importance to determine whether the inclosure mentioned consist of slag or of sulphide of manganese, the latter usually occuring in the form of round drops, which, if large in size, may be elongated by the rolling. Sulphide of manganese is best recognized by etching the surface of the fracture with a mixture of dilute hydrochloric acid and bichloride of mercury, when the sulphur appears as dark spots. A print also may be taken conveniently by exposing the fracture for four or five minutes to a piece of silk wet with the solution.

It may be of interest to many to hear that ruptures have also been found to start from groove marks on the steel, where numerals or other marks have been stamped by the drill runner.

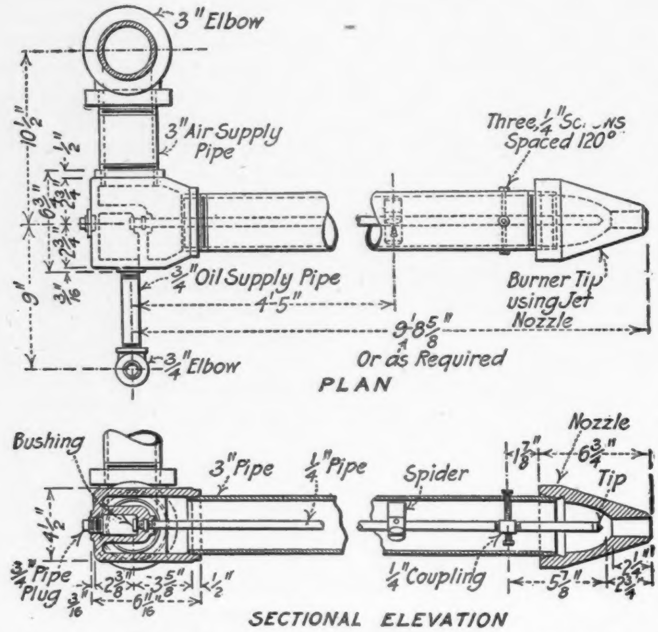
It is evident from what is now said that the annealing of the drill steel at intervals will mean only a partial improvement. Internal strains produced by cold working of the metal and coarse-grained crystals may be effaced, but there is no possibility of eliminating ruptures of the second class metal. This is in accord with what has been found at various Swedish

mining fields where the practice is to anneal drills every second month.

So far as the steel problem is concerned, the structure of steel exposed to vibrations has proved to be of utmost importance. The carbitic structure has been found to stand up best. It is obtained either by cooling the steel quickly through the so-called critical range without actual quenching, or by rapid cooling and then reheating to about 600° C. *Eng. & Min. Journal.*

horsepower per furnace-day being required to heat the oil from the line temperature to the burning temperature. The oil is fed by gravity (34 lb., static pressure) through seven burners.

The No. 2 reverberatory furnace, on which a series of tests were made, has the following dimensions at the skimming line: Length, 132 ft. ½ in.; average width, 18 ft. 10 in. The air supplied to the burners for atomizing and burning the oil amounts to about 10% of

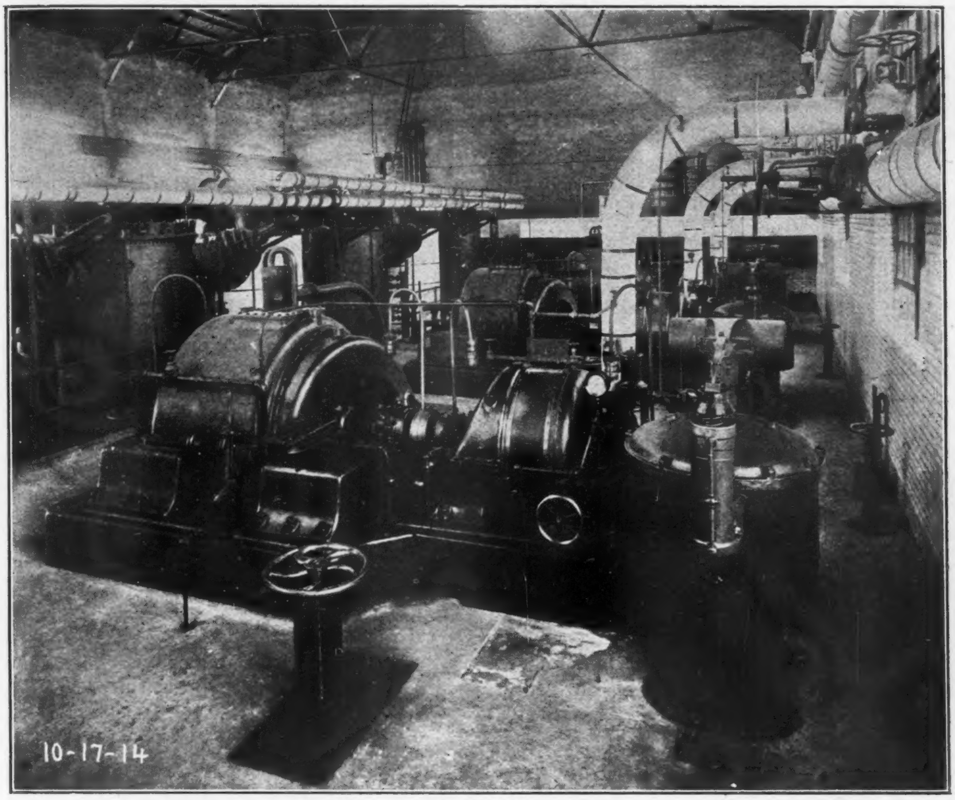


LOW-PRESSURE OIL BURNERS—STEPTOE TYPE

LOW PRESSURE OIL BURNERS

The cut shows the essential features of low pressure oil burners used on the reverberatory furnaces of the Steptoe Valley Smelting & Mining Company, McGill, Nev., as described by R. E. H. Pomeroy in the Bulletin of the American Institute of Mining Engineers. The air for these burners is supplied at a pressure of only 40 oz. by a motor driven Connersville blower of 42-cu. ft. capacity per revolution. The oil is crude petroleum having a specific gravity of 16.5° Bé., flashing in open test at 199° F. The oil is heated to about 200° F. in a steam heater before going to the furnace, about nine boiler

the theoretical air necessary for complete combustion, the remainder of the necessary air enters the furnace through the burner openings in the firing wall. No checker holes are provided and the charge holes in the roof are equipped with slide gates and "dog houses" to minimize air leakages. The combustion of the fuel is practically complete, the carbon monoxide in the effluent gases being less than 0.5%. The draft at the firing end of the furnace is 0.18 in. of water; in the uptake above the verb the draft is about 1 in., and in the stack 1.4 in. The top of the stack is about 320 ft. above the skimming line of the furnace.



TURBO GAS BOOSTERS

The half-tone above shows a power house interior of the Maryland Steel Company, Sparrow's Point, Md., in which are seen three Rateau Smoot centrifugal gas exhausters installed by the Southwark Foundry & Machine Co., Philadelphia.

Each machine as here shown is direct coupled to a Rateau steam turbine, and has a normal capacity of 900,000 cu. ft. per hour when receiving by-product coke oven gas at 122° F., sp. gr, .40 to .50 (at 60° F., referred to air = 1), the gas being delivered to the machine at a pressure of 10" water column below atmosphere and discharged, at a pressure of 3.75 lbs. per sq. in. above atmospheric.

The steam turbines are designed for a steam pressure of 90 lbs. to the sq. in. and vacuum 26 ins. The maximum capacity may be obtained when running non-condensing. Normal speed, 3900 r. p. m. The Exhausters are of three-stage type. Each impeller consists of a set of forged steel radial blades dovetailed into the shaft, forming a rotating element of unusual strength and stiffness. The operating speeds are well below the critical speed. The passages and guide vanes are shaped to allow the gas to enter and leave the impellers without shock and insure high efficiency. With this construction, also, end thrust is eliminated.

The unit is equipped with a constant suction relay governor with 36" bell, which regulates the speed of the turbine to maintain a constant pressure in the gas collecting main within 2 mm. water column. A centrifugal fly-ball governor is provided on the turbine shaft, which acts as a speed limiting device and controls the admission valve directly. Two exhausters are in use constantly, one for rich gas and one for lean gas from the koppers by-product coke ovens. The piping is so arranged that the No. 1 machine handles rich gas, the No. 3 machine handles lean gas, and the No. 2 machine may be used for connection to either gas main.

LEAD WOOL AND PNEUMATIC CAULKING

The following is an abstract of a paper by C. E. Reinicker, of the People's Gas Light & Coke Company, Chicago, before the Illinois convention. The paper was entitled "The Use of Lead Wool as a Jointing Material, with Especial Reference to a 36-inch Main," and it told of the experiments which led to the adoption of lead wool and pneumatic caulking.

In the first use of lead wool by this company hand caulking was employed, the comparatively small number of joints on each individual installation rendering less conspicuous the excessive cost which would be encountered on a long line of street main.

The company had experimented with pneumatic caulking in 1908, but because of the crudeness of the apparatus, unfamiliarity with the process, some prejudice on the part of the operators and also that the joints on which it was tried were filled with cast lead, the method proved unsatisfactory and was abandoned. The paper then describes at considerable length various experiences and the results of tests and investigations having in view the installation of a new 36 in. main more than 13 miles long. An experimental line equipped with lead wool joints was found to be the only one in which a majority of the joints were "bottle tight."

With the question of the material decided upon, the next step to be considered was the calking. Because of the cost of hand calking this method was not to be thought of in connection with this long line, and it was finally agreed that pneumatic calking was the only available method promising economy.

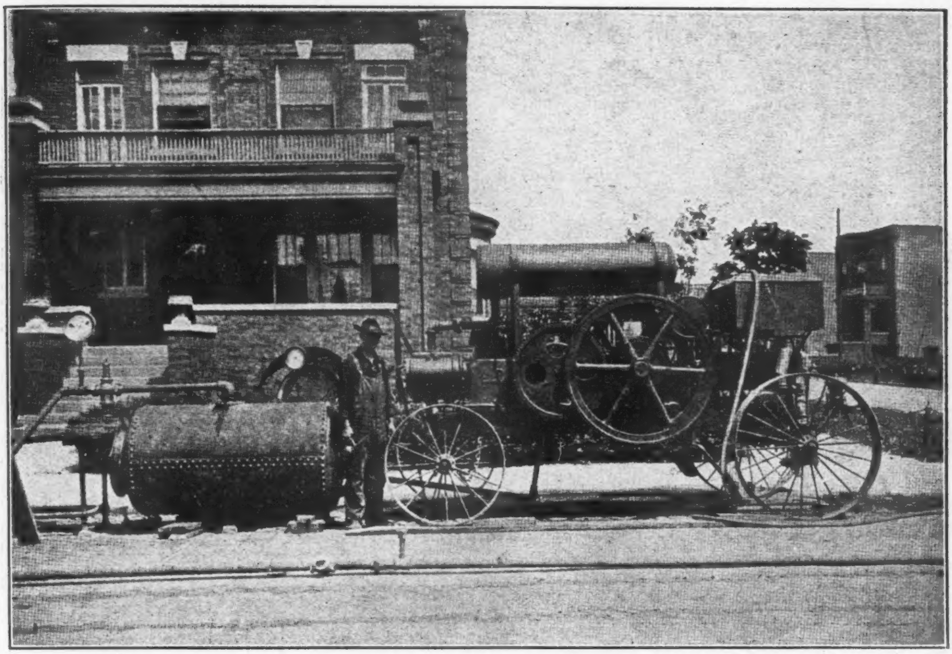
A complete and systematic organization of the supervising and working force was completed before the work was begun. An engineer was placed in charge of the engineering details of the whole route, whose duty it was to see that proper grades were maintained, and that obstacles in the line were removed.

Four gangs were organized for the actual work, the details being as follows: Foreman in charge of the gang; apprentice engineer; foreman of calkers, or inspector of joints; machinist in charge of compressor; time keeper; tool keeper; various straw bosses as necessary. Each gang averaged 130 men and had about ten calkers. For instructing those men who will be directly in charge of the work, a "course of Instruction for Street Men" was started to give the men experience approximating actual conditions; a 36 in. joint was used, made of a short bell and a short spigot of pipe. The bell piece was cut into two parts, the cuts being diametrally opposite and the two halves then held together by bands running around the pipe and fastened by heavy bolts. When a joint was calked the bell piece was then separated, thus exposing the yarn and lead and immediately disclosing the character of the work. Each pair of calkers was required to calk two or three joints in one visit to the shop, and returned for further practice in two or three weeks. From March 11 until April 12 fifty-three men received instruction and training in this method of calking, during which time seventy-six joints were calked and four or five tons of lead wool were used. A close record was maintained of the performance of each man, both regarding the time of operation and the materials used, and by this method a fair comparison of the relative merits of the operators was made possible. To determine the correct amount of calking material which should be used, other 36 inch joints were made up with both lead wool and cast lead, driven up with pneumatic tools and also by hand.

The samples pneumatically calked were uniformly more dense and their specific gravities nearer to the true specific gravities than the hand calked samples. Also, the gravity of the ring of lead wool back of the recess in the bell was more dense and its specific gravity nearer to the true specific gravity than like samples from the cast lead joint. Therefore this test showed that the best and most uniform results were obtained from lead wool calked with pneumatic hammers.

Tests on the relative specific gravities of the calked product under a differing pressure at the compressor show that a specific gravity more nearly approaching the true specific gravity is obtained when the pressure at the compressor is 80 lb.; or, in other words, that a more dense joint is possible with this pressure than with 100 lb.

After these tests it was decided that the 5 inch joint on the 36 inch pipe should be made as follows: Three inches of yarn was to be first inserted and calked by the pneumatic hammers, the weight varying as the size of the joint varied, averaging about 6 or 7 pounds. The remainder of the joint, 2 inches, was to be



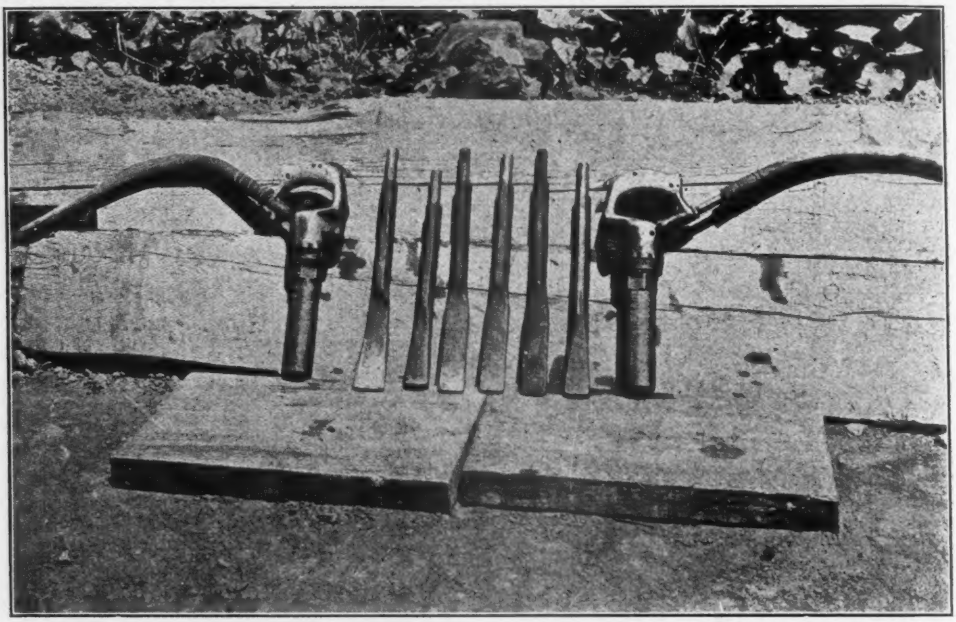
PORTABLE GASOLINE DRIVEN COMPRESSOR.

filled with lead wool, weighing about 75 lb.; this weight also depending upon the size of the joint.

EQUIPMENT.

The portable compressor outfit consisted of a 15 h. p. Otto gasoline engine, 225 r. p. m., directly geared to an N. E.-1 Ingersoll-Rand compressor, 170 r. p. m., with a cylinder size of 8 inches by 8 inches and delivering 76 cubic feet of free air per minute at a pressure of 80 to 100 pounds. Mounted on the frame with the engine and compressor was an auxiliary compression tank 18 inches by 6 feet, and all other accessories, the whole having a shipping weight of 7,200 pounds. Plate No. 1 presents a comprehensive view of this outfit. In connection with each outfit a storage tank 3 feet by 6 feet was provided, so that from 6 to 8 pneumatic hammers could be used at the same time by each gang, since without this tank only 5 hammers could be used simultaneously. The calkers worked in pairs, each man being equipped with a 15-53 H. Ingersoll-Rand Crown valve pneumatic hammer, having a 1⅛-inch bore and a 3-inch stroke, and delivering approximately 1800 blows per minute, Fig. 2 showing the hammers. In addition to the eight hammers used on each gang there were seven additional ones supplied, so that a defective hammer could be replaced without loss of time. In addition to his pneumatic hammer each calker was given a set of eight calking tools and each pair of calkers was provided with a pail containing a hammer wrench, a 10 in. Stillson wrench, an oil can, three cold chisels, one hand calking hammer. The air was carried in a 2 in. steel pipe laid along the side of the trench about 600 feet each way unions every two lengths. At every 20 feet from the compressor and joined by Dart a branch was taken off this line, the branch divided to supply two air hose. Each of these two branches had a valve and attached to it 25 feet of ½ inch hose directly connected to the hammers, this connection being shown in Fig. 3. By this arrangement it was possible to calk a large number of joints without moving the compressor and with no appreciable loss of pressure.

The bell and spigot of the pipe were cleaned before laying, and extreme care was used to carry the pipe home. The centering and blocking were carefully done, so that an even joint would be assured at all quarters of the pipe. After this was accomplished a piece of yarn



HAMMERS AND CALKING TOOLS.

specially prepared for the purpose was tucked into the joint to exclude the dirt, this yarn remaining in place until the calkers were ready to begin work on the joints. The yarn used in calking the joint was prepared at the "camp" and fastened in bundles of various weights, this weight ranging about 7 lb.

The lead wool was shipped to the gang in sacks of 100 lb. each and it was then rolled into suitable lengths for inserting into the joint, and definite amounts weighed out. This amount varied as the diametral thickness of the joints varied, and it was the endeavor to provide as little as possible over the actual amount needed, to reduce the waste to a minimum, therefore if the joints were averaging 70 lb., 75 lb. was provided; if they were averaging 75 lb., 80 lb. was provided, and so on.

The first step in the joint work was the removal of the yarn which was tucked into the joint at the time it was laid. After this was done, and as a means of additional precaution against dirt, the air hose was used to blow out any that might have been admitted before the joint was protected by the yarn. The first permanent yarn, consisting of about 6 strands was then pushed into the joint. After this was in place and any excess length cut off, it was calked with pneumatic hammers. After this first was tightly driven another layer of yarn was inserted consisting of 8 or 9 strands, the same procedure being followed as in the first case. This method was carried on until the yarn came to within the required 2 inches of the face of the bell, at which point the lead wool was to be started.

Before using the lead wool a shallow galvanized iron pan was placed under the joint to catch any waste that might drop during the calking. Two strands of lead wool were introduced all around the joint, the calkers working from the bottom upward and continuing to the top. When these strands were driven up and even, a third strand was inserted, and so placed as to break joints with the first rings calked. After the joint was finished, the lead wool and yarn that remained, together with the waste lead in the tray under the joint, was gathered up and returned to the "camp," where it was weighed.

After a sufficient length of main was completed to warrant testing, a test was made, taking the air from the compressor. After 15 lb. was reached, each joint was carefully gone over with soap and water. Since the number of the joint was recorded in the name of the men who did the work, it was easily seen which men were negligent. As a matter of fact, except for the first joints calked, few were found lacking under test.

Since the number of joints possible to calk in a day depended on the number of feet of pipe laid, and since this latter depended on the character of the subsoil encountered, a statement of the number of joints calked daily would be of no value. It was necessary, however, that each gang should calk on an average 10 joints per day in order to finish the work on schedule time. There were times, under favorable conditions, when a pair of calkers finished 5 or 6 joints in a 9 hour day; and there were also times when it was possible to lay only 3 or 4 lengths, so only one joint was calked by each pair. As a general average the time of yarning was 43 minutes and that of calking 1 hour and 14 minutes. It was found advisable not to use any lead wool that had become wet, therefore a canvas cover was provided for each bell hole for protecting the men and the lead during a slight fall of rain, and also to provide a shelter for the calkers from the sun during the heat of the day. Rainy days were used to test the line laid, if this were possible, and on this phase of the work some interesting figures were obtained. It required two compressors 2 hours and 45 minutes to fill 2,568 feet of main and one compressor 4 hours and 30 minutes to fill 2,028 feet of main with air at a pressure of 15 pounds.

REPORTS AND FIGURES ON WORK.

To keep accurate records, daily reports on each gang were filled out by the apprentice engineer. The total number of joints calked was 5,917. The average cost per joint was $7.46, divided into $1.04 for labor and $6.42 for material. The average weight of the material used in each joint was 6.2 pounds of yarn and 72.4 pounds of lead wool. The total number of feet of pipe laid was 69,553, at an average cost of $7.09 per foot. The cost figures are actual shop costs determined from the daily reports and do not contain any overhead expenses.

After this main was finished and gas at 5 pounds pressure put into it, everyone connected with the work waited with an air of expectancy for complaints of leaking joints, and it was with incredulity and amazement that it was seen the main held tight, but one break developing. Several stretches of this line have been exposed through other main operations, in all about 150 joints being uncovered at different points, and they are without a fault.

MEN AT WORK.

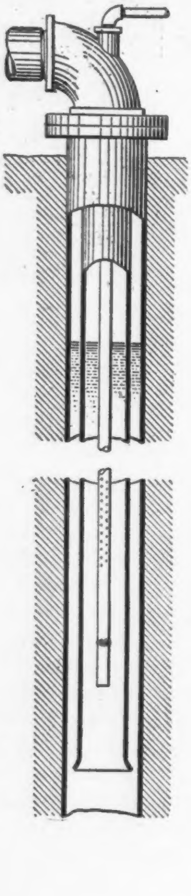
Practically the entire 36-inch main was laid with lead wool furnished by the New York Lead Wool Co., only enough of the product of the United Lead Co. being used for experiment. The product of each of these companies was entirely satisfactory, there being little choice between them. Specific gravity tests showed that each was composed of lead of a high grade of purity, and when calked closely approached the true specific gravity of the fused metal. The change from the use of lead wool furnished by the New York Lead Wool Co., to that of the United Lead Co. was entirely due to the fact that the product of the latter company was supplied in continuous strands, coiled on reels. This aided in eliminating waste and provided an easier means for transportation and handling.

A minor change has been made in the compressor outfit, in connecting the auxiliary storage tank to the compressor by means of a metallic hose, thus eliminating vibration. Air is maintained at 100 lb. in the tank, the outlet having a reducing valve which cuts the pressure to 75 lbs. By this means it has been found that a more uniform supply could be maintained when all the hammers were operating, and also obtaining better joints with the lower pressure.

The efficiency which may be obtained through the use of lead wool and pneumatic calking on large lines of bell and spigot pipe which are to convey gas at even moderate pressures should strongly commend it to gas engineers.

AN AIR LIFT PIPE THAT WILL NOT CLOG

It is not uncommon in using an air lift, to deliver the air through radial perforations in the air pipe near its bottom. Trouble is sometimes experienced in such cases by the clogging of the perforations with precipitate or scale. E. M. Ivens, writing in *Power*, describes a method of avoiding this difficulty. A section of pipe is added to the line below the perforations, as illustrated, and the lower end left unplugged. Thus any scale or dirt is allowed to escape downward while the air follows the path of least resistance through the perforations. Should the perforations eventually become clogged, the air will still have a path open at the lower end. Its use of this path will allow the lift to operate, but will be detected on the gage. The operator can then clean the pipe when most convenient.



A NOVEL AIR COMPRESSOR STUNT

The operating plant of the Canadian Mining & Finance Company, Timmins, Ontario, comprising, mine hoist, air compressor, underground pumps and concentrating mill, is all to be operated electrically, current being supplied from an outside source. To guard against possible delays and to ensure constant operation an additional steam power plant was considered for emergent use. This would have required not only steam boilers but also steam engines of adequate power and electric generators, but in this case only the boilers will be required on account of the two-fold function to be assumed by the compressor and its motor.

The compressor is a two-stage cross-compound Nordberg machine of not unusual type, having cylinders 37 and 22 in. diameter by 31 in. stroke with mechanically operated Corliss valves, both for inlet and discharge. It is to be driven by a 25 cycle synchronous motor at 105 r. p. m. By a slight readjustment of the valves, some changes of connections and a reversal of rotation the compressor is converted into a steam engine and the motor becomes a generator supplying current for driving everything as before except that of course, so far as the story goes, there is no longer any supply of compressed air, and for a mining operation the air would seem to be quite a necessity.

MANY USES FOR LIQUID AIR

That the liquefaction of air is no longer a mere laboratory achievement is far from being generally realized. Many, even accomplished engineers, are astonished when informed that it is now an important industrial process.

ENORMOUS PRODUCTION.

Yet it is certain that, from the plants already in existence on the Linde and Claude systems, there must be produced well over 30,000 gallons of liquid air hourly. Of this output, by far the greater part is utilized in the production of pure oxygen. But a rapidly increasing number of installations are being put down for the manufacture of nitrogen, while the neon which is readily extracted as a by-product, is finding a useful application in industrial lighting. Experiments, giving good results, have also been made with liquid oxygen explosives; and a number of liquid-air

plants have been put down for the production of hydrogen.

The separation of the oxygen and nitrogen is effected by liquefying the air and re-evaporating it slowly. The difference in the boiling points of the oxygen and nitrogen causes most of the nitrogen to come off as a gas, and most of the oxygen to remain behind as liquid. A special form of rectifying tower enables the separation to be completed. In the manufacture of oxygen, the liquid-air process has superseded almost all others, chiefly owing to the low cost of production which it permits.

OXY-ACETYLENE BLOW-PIPE.

The increase in the consumption of oxygen is almost entirely due to the successful application of the oxy-acetylene blow-pipe for welding and cutting metals. In 1911 the consumption of oxygen in Germany was 150,000,000 cubic feet, in France 100,000,000 cubic feet, and in England about two-thirds of that amount, and it is estimated that at least 90 per cent. of these totals was used for oxy-acetylene work, about one-half of this amount for welding and one-half for cutting. There are, it is stated, some fifty liquid-air oxygen plants at work on the Continent of Europe, and the British Oxygen Company in this country has all of its eight factories equipped in this fashion. But in the United States only five liquid-air oxygen plants had until recently been put down, although there are in operation at least two electrolytic installations.

NITROGEN FOR FERTILIZERS.

The market for nitrogen among makers of artificial manures is a large and growing one, and in supplying it liquid-air plants seem destined to be brought more and more into use. At present the world's consumption of nitrogenous fertilizers is upwards of 4,000,000 tons annually, and it appears certain that this figure, as virgin soils become exhausted, and the natural sources of supply in Chile diminish, will be greatly exceeded. Even as it is, liquid-air plants are in existence whose combined capacity will produce enough nitrogen to make 250,000 tons of calcium cyanamide yearly.

Formerly the nitrogen for this process was all supplied from the Birkeland and Eyde plants, which extract it from the air by electrical deposit. The efficiency and cost of working of the Birkeland and Eyde process, however, compare very unfavorably with those of liquid air. The cyanamide, as is well known, is made on the Frank-Caro principle, by passing pure gaseous nitrogen through retorts containing calcium carbide, heated to about 800 degrees Centigrade. For this purpose a purity of 0.997 is demanded, and a purity of 0.998 and over has, on the Claude and Linde processes, been obtained. On the Claude system nitrogen selling at 1 franc can be produced for 50 to 60 centimes per kilogramme.

Liquid air is also used indirectly in connection with at least two other nitrogen processes, in which it is necessary, or at least advantageous, to use an excess of oxygen. The more important of these is the Birkeland and Eyde method of extracting the nitrogen from the atmosphere by electrical deposit. In this process it has been found that if, instead of air, a mixture of nitrogen and oxygen in equal volumes is used, a yield may be expected of at least 625 kilogrammes of nitric acid per kilowatt-year, instead of only 500 as at present.

The other process, due to Haeusser, depends on the fact that after combustion at a high temperature—by an explosion of gas, for example—a part of the nitrogen in the air burns, and remains oxidized, if the explosion is instantaneously followed by rapid cooling. In this process also it has been found that an excess of oxygen in the air has large effects on the yield to be expected.

Finally, nitrogen made by the liquid-air apparatus has found a use in the manufacture of aluminum nitride from bauxite (Al_2O_3). The nitrogen is passed over a mixture of three volumes of charcoal to one of bauxite, heated to whiteness, and the nitride and carbon monoxide are produced. For supplying the nitrogen for this process a Claude plant, with a capacity of 300 cubic meters per hour, has recently been put down in France.

In the manufacture of hydrogen the liquid air does not, of course, form the raw material, but is used externally. The raw material is water-gas, the composition of which is 48 to 54 per cent. hydrogen, 42 to 44 per cent. carbon monoxide, 2 to 5 per cent. carbon dioxide, 3 to 5 per cent. nitrogen. Carbon dioxide is easily removed by absorption in lime, and since, of the remaining constituents, hydrogen has by far the lowest boiling point (— 253 degrees Centigrade), it can easily be separated by liquefying the other gases with liquid air, and al-

lowing the hydrogen to escape as a gas into a suitable holder. The liquefied mixture, which is mainly carbon monoxide, is conveyed to an internal-combustion engine, and thus serves to develop the mechanical power necessary to drive the installation. Suitable interchangers are provided, as in the liquid-air plants for economizing the cooling effect. The process is due to Messrs. Linde, Frank and Caro.

USES OF HYDROGEN.

The outlet for the hydrogen is chiefly for the conversion of oils into the fats required in soap and margarine making, etc. It is also employed for inflating balloons, and, in the manufacture of metallic-filament lamps, for the envelopment of the filament during its preparation and reduction; and recently a Linde plant, with a capacity of 2,000 cubic meters per hour, has been put down by the Badische Anilin for use in the manufacture of synthetic ammonia.

An advantage of the liquid air over the electrolytic process is that excess hydrogen passed through the oils, and thereby rendered impure, and hydrogen that has become diluted with air in balloon work, can be returned to the apparatus and readily purified by condensation of the foreign matters. In addition to hydrogen, nitrogen has been used extensively for the envelopment of the metallic filaments during their manufacture, but it is expected that both of these gases will be replaced by argon, which can readily be produced from the liquid-air apparatus as a by-product. Argon may even be utilized in lighting tubes, similar to the neon tubes about to be described.

NEON.

Nitrogen and oxygen are naturally the two principal products of the liquid-air process, but neon—once regarded as a rare gas—is produced as a residuum from the Claude apparatus in no inconsiderable quantities. In fact, from a plant with a capacity of 50 cubic meters of oxygen per hour, about 100 liters are produced per day, the proportion present in the atmosphere being 1 in 66,000. It is well known that neon offers an exceptionally small resistance to the passage of the electric discharge. This property inspired M. Claude with the idea of using the gas obtained from his apparatus in lamps, similar to the Moore nitrogen tubes, and after some difficulties he has met with a fair measure of success. Neon lamps made by him were used to illuminate the colonnade of the Grand Palais des Champs Elysées on the occasion of the Automobile Exhibition in 1910, and fifty of his neon tubes, each 6 meters long, decorated the church of St. Ouen at Rouen during the fêtes of the Norman Millenary.

EXPLOSIVES.

The use of liquid oxygen in explosives promises to be considerably developed in the future. In the early experiments of Linde, the liquid containing 50 per cent. of oxygen, which was obtained from his original apparatus, was poured on to fragments of wood charcoal from 2 to 4 millimeters in size. The fragments were kept from scattering, as the liquid boiled, by making them into a sponge with one-third their weight of cotton-wool. In more recent experiments, at the cutting of the Simplon Tunnel, a mixture in equal proportions of carbon and petroleum, which took up eight parts of liquid oxygen, was used with some success, and lately excellent results have been obtained by Messrs. Claude and D'Arsonval working in collaboration for the French Government. The chief object of their investigations was to produce an explosive which gave rise to no injurious gases. For this purpose a mixture of powdered aluminum, with an excess of liquid oxygen, was tried, with a very encouraging success, and the explosive was found to be equal to twice its weight of gunpowder. Further experiments by the same investigators with carbon-oxygen explosives show that these have the same power as dynamite, and, as the cost of each of the constituents is less than two cents per pound, it is predicted that the new explosive will, as soon as further experiments are completed, be widely used. The principal difficulty in the way of its adoption is the transportation of the liquid oxygen, but this should shortly be overcome.—*Engineering*, London.

Official announcement has been made by the Bureau of Mines that the cost of production of the 300 milligrams of radium bromide it has so far made was at the rate of $60,000 per gram ($1,700,000 per oz. Avoirdupois) and this is said to be a marked reduction from the prices formerly prevailing in the open market.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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THE PANAMA PACIFIC EXPOSITION

It might easily be charged against Compressed Air Magazine that it has not done its duty in the way of promoting the publicity of the great international exposition now getting into full swing. In fact the gigantic enterprise has been so long, so voluminously and so efficiently advertised that our help was not needed, even if it could have been of any account. No world's exposition has ever made larger promises and none has more magnificently fulfilled them.

The exhibition occupies two and a half miles of the water front of the Golden Gate with a range of green hills for a back ground when viewed from the waters of the bay, and here are picturesquely grouped a collection of great buildings upon which have been lavished the skill of great architects and the decorative resources of the artists in color and form. On one side or end of the show proper are the buildings erected by the different States of the Union and foreign countries represented at the fair, with race track and fields for aviation and outdoor sports, and at the other is a region called The Zone, given over to popular amusement patrons.

All this is merely the outside. There are 80,000 exhibitors represented on the grounds, and, rather curiously, it is stated that the total weight in exhibits handled by the traffic department is 80,000 tons. There is practically no limit to the range and variety of the exhibits. All interests and tastes will be catered to and none can go empty away. The things which would have been shown but have been held back by the war will scarcely be missed in the mass actually presented.

There is every promise of a record breaking attendance. The foreign visitors may be few indeed, but those who have been kept away will be outnumbered many times over by these from this side who in a normal year would have visited Europe but now will go to the Pacific Coast instead. Not least among the things accomplished by the exposition will be the impulse given to many Americans to see their own country.

Most notable will be the official meetings of organizations of every type. There will be the Engineering Congress and the individual gatherings of the various technical societies. Nearly four hundred state, national and international associations have signified their inten-

tion to hold conventions and reunions at San Francisco during the season, and for these ample accommodations have been provided. Most of these will be held in the special Convention Hall on the grounds, but there will also be many important and interesting gatherings in the State buildings and elsewhere. This opportunity of a lifetime strongly appeals to every American, and in fact to every one in touch with modern civilization.

NEW BOOK

Tunneling, Short and Long Tunnels of Small and Large Section driven through Hard and Soft Materials, by Eugene Lauchli, 248 pages, 6 by 9 in. nearly 200 illustrations, McGraw-Hill Book Company, New York. Price $3.00.

This is an excellent work prepared by an engineer of wide experience both in the United States and in Europe, who has the faculty of orderly, concise and comprehensive presentation without the introduction of any extraneous matter. The work is composed to a large extent of results of personal observations and studies, together with data collected from direct and reliable sources. It adheres strictly to the one topic and presents genuine information and reliable records of tunneling actually accomplished. It also fully discusses means and methods and deduces practical reasons for their selection and adoption under different conditions. W. L. S.

THE ADVERTISING PAGE AND ITS VALUE TO THE READER

BY CHAS. A. HIRSCHBERG.

It has been aptly said that "Salesmanship is the Sale of Goods for Profit." It should be for the profit of both the buyer and the seller; the buyer first of all. Before the maker can hope to profit, the goods must profit the user.

Advertising from the reader's angle, is the means by which he is put in touch with an article for which he has need. From the manufacturer's viewpoint, it is the means by which he makes known to the reader that he has something to sell that will profit him in his work, whether it be a new device or a better way to utilize an old one.

Advertising has a big mission to perform. It disseminates information and increases knowledge. It informs, interests, educates and inspires. It tells the reader of new developments in the field of manufacture. Something new is being discovered every day. For instance, the Jackhamer drill is a far different and better machine than the reciprocating drill of yesterday. It has effected a decided increase in the speed of drilling rock for blasting. In many cases it has almost doubled the progress formerly possible, and at the same time has lowered the items of labor and power cost.

It was the advertising page that first put you "wise" to this wonderful little tool, and the same is true of a large percentage of your mine equipment.

Advertising interests because of the part it plays in informing the readers of the progress John Jones is making on work akin to his own. In that way it educates him in better means and ways of doing things, and it inspires the emulation of the successful neighbor.

It is incumbent upon the subscriber to read the advertising page and to study it carefully, for tomorrow may bring forth a better Jackhamer drill; something with which to supplant the thing of today, making that job more quickly accomplished, safer and at a lower cost.

Advertising tells how to economize; how to increase production and how to conserve resources. It goes further. It is the acid test of quality, for a poor article cannot survive the test of continuous publicity any more than it can stand close personal inspection, therefore advertising, extensive and persistent, is in the nature of a guarantee of quality. It shifts the responsibility of selection from the purchaser's shoulders onto the advertiser. It is an insurance against misrepresentation and against trouble.

When you buy advertised goods you don't buy blindly, for you are enabled to choose your purchase from the entire manufacturing field. In other words, it is like dealing with a big department store, with its extensive lines of goods from which to choose.

Advertising has brought the four corners of the world into intimate relation with each other. The man in Alaska is told how the man in Arizona does things and the kind of equipment he uses to obtain his results. The man in California profits through the knowl-

edge the advertising page conveys of a new and better drill, compressor or drill sharpener, built perhaps in Pennsylvania, New York, or some other corner of this big country of ours.

You may not need the article immediately, but in reading the advertising page you are fortifying yourself against tomorrow, against the inevitable day when the march of time and progress will demand the adoption of other means and other methods to successfully cope with your problems.

The very fact that you are willing to pay $1, or whatever the subscription price may be, is an indication that you read the text pages with the object of keeping in touch with your field, for unless you do you are not getting the worth of your subscription price. But, on the other hand, are you really getting your money's worth if you neglect the advertising pages?

Good advertising vies with the text pages in point of interest, instructiveness and value; it is confined not merely to a brief description of the goods, but also invariably contains a citation of performance, of upkeep, and the cost of doing things out in the field. This is as it should be, for the manufacturer is usually in closer touch with the work out in the field than the editorial departments of the paper, at least, on such jobs where his equipment is being used.

There is a service which the reader can perform for the publisher and the advertiser that in the long run will accrue to the benefit of the industry. When writing the manufacturer mention the advertisement and the name of the paper. This is but a small thing to ask of the reader. On the other hand to the publisher and the advertiser it is of extreme importance, for it enables the advertiser to spend his money judiciously and helps the deserving paper.

How many are willing to admit, for instance, that the Leyner Sharpener that is saving from 25 to 75% in the cost of sharpening drill steel first came to their attention through the advertising page, that, perhaps unconsciously, it was the advertising page that led to its purchase? And if you are willing to admit it, do you do so?

The survival of a product on the advertising page is the true test of quality, for no manufacturer could long afford to advertise an inferior product—therefore, in buying advertised goods lies your "protection."—*Min. & Eng. World.*

TUNNEL CANALS IN ENGLISH COAL MINES

Tunnel canals are by no means uncommon in England, but the Bridgewater subterranean canal is quite different from the other coal lands; indeed, says the Technical World Magazine, there is nothing quite like it elsewhere in Great Britain, or, for that matter, in any other part of the world.

John Brindley, the engineer in charge when the canal was built in 1759, laid down within his coal mines a system of underground railways, all leading from the face of the coal (where the miners were at work) to the shafts which he had made at different points in the tunnel, through which the coal was shot into the boats waiting below to receive them.

First a large basin was excavated at the entrance to the pits at Worsley, capable of holding a number of specially constructed barges and serving as a head for navigation. From this basin the barges entered the mine by means of an underground canal with two semi-circular arches or mouths, and moved for a mile right up to the different workings. Subsequently, the canal extended for about six miles and then branched out in different directions with the total length of nearly 40 miles. Where the tunnel passed through rock it was simply hewn out. This underground passageway, therefore, acted not only as a drain and water feeder for the canal itself, but also as a means of carrying the facilities of navigation to the very heart of the collieries.

Worsley Basin lies at the base of a sandstone cliff several hundred feet high, covered with luxuriant vegetation. The smaller aperture is the mouth of a canal which runs for about a mile, and serves to prevent the congestion which would inevitably be caused by the entrance and egress of so many barges passing through a single passage. The other archway is the entrance to a wider channel, which extends for several miles to Bolton, and from which other canals diverge in different directions. The barges were long and narrow, each holding about 10 tons of coal, and were drawn along the tunnel by means of staples fixed in the wall. When the barges were empty, and consequently higher out of the

water, the bargemen propelled themselves along the "legging," as it is called.

In the tunnels of early date, towing paths were never constructed and, except where steam haulage is in use, the method of propelling boats through such tunnels, down to the present time, is either "shafting" or "legging." "Shafting" consists of pushing with a long pole, or shaft, against the top or sides of a tunnel while walking from forward aft along the boat, and is generally only used in short tunnels.

"Legging" is usually performed by two men one on each side of the boat at the fore end, who lie down on their backs and push against the tunnel sides with their feet. If the tunnel is too wide to admit their reaching the side wall with their feet from the boat's deck, boards projecting over the boat's side, termed wings, are brought into use for them to lie on. When the roof of a tunnel is low, one man can "leg" an empty boat lying down on the top of the cabin.

"Legging" is hard work, and it is difficult to realize that in former days it used to be performed by women as well as by men. At tunnels where the traffic is good, professional "leggers" are in attendance, who take their turn assisting boats through as required. At the old Harecastle Tunnel a "legger" may be engaged for less than half a dollar for the passage through, which generally takes about three hours.

The canals are still in use, but women have dropped out of the profession.

IMPORTANT CHEMICAL DISCOVERIES

The Bureau of Mines is doing remarkably efficient work in various fields and its latest achievement is an epoch maker. Secretary Lane announces simultaneously the discovery of two related chemical processes, one of which will greatly increase the supply of gasoline, while the other may make the United States independent of all the world for its supply of essential materials required in the dye industry and in the manufacture of high explosives. It is promised that by the first process the gasoline output of the independent refiners may be increased from 12,000,000 barrels a year to 36,000,000 barrels, or greater than the total production of the entire world. By the second process the important products toluol and benzol, which have heretofore been obtained from coal tar, are produced from crude petroleum. These are important bases for both dye stuffs and high explosives.

These discoveries are the result of years of research by Dr. Walter F. Rittman, chemical engineer of the Bureau of Mines, the work having been done in the finely equipped laboratories of Columbia University. To prevent monopoly in the use of these discoveries Dr. Rittman has applied for U. S. patents, these to be dedicated to the whole American people.

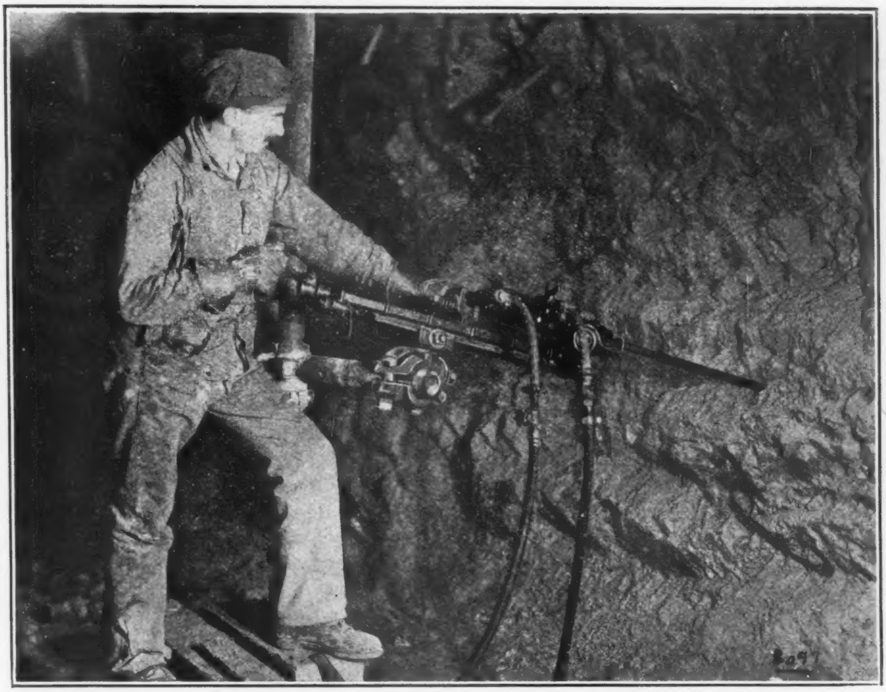
MOUNTED JACKHAMER DRILLS

The Jackhamer drill was originally designed for drilling down-holes of various depths up to, or rather down to, about 12 ft.; but, due to the light weight of the machine, which is around 40 lb., it was found thoroughly feasible to employ it for drilling holes approximately horizontal as well. When such "flat" holes are to be drilled intermittently the regular unmounted Jackhamer is a thoroughly practical tool, but where continuous drilling of flat holes has to be carried on, the effort of holding the drill to the work is apt to tire the workman.

Realizing the demand for a mounting that would not be cumbersome, but that at the same time would be heavy enough to withstand rough usage, there has been developed, after considerable experimenting, the mounting shown in the accompanying illustrations, which is known as the "JM-6" type

The Jackhamer, used in conjunction with the "JM-6" mounting, has been found thoroughly practical for such flat-hole work as drifting and underhand stoping in metal mines, where shallow holes are required, and for breaking down coal and driving gangways in coal mines.

It is but an instant's work to clamp the standard unmounted Jackhamer in the carriage of the "JM-6" mounting. Therefore, a single drill may be used conveniently for the two-fold purpose of drilling flat holes in the heading and for down holes on the bench without loss of time in making changes. Whether used as a mounted or a hand drill the Jackhamer retains all the advantages due to its rapid drilling speed, its self-rotating feature and the efficient means for keeping the drill hole clean. A water feed device of the Leyner type has recently been developed for



MOUNTED JACKHAMER.

use with the Jackhamer whenever trouble from dust arises. The "JM-6" mounting is adapted for use with both plain and water-feed types of Jackhamers. The clamp which grips the handle of the drill is provided with a cushion spring to take up the shock when a steel is being pulled out of a hole. The forward clamp on the carriage does not grip the machine firmly, but serves only as a support and guide.

The "JM-6" mounting is adapted for use either on the arm of a vertical column or a horizontal shaft bar, and the cone upon which the shell rests will fit into any 5-in. Sergeant saddle or clamp. The sliding cone gives a quick adjustment when setting up and can be used to increase the length of feed whenever necessary. The length of the screw feed is fully 24 in. Adding to this the slide of the cone on the shell, which is over 19 in., it will be seen that a total travel of over 43 in. may be obtained whenever desired. The total weight of the mounting is 63 lb. Steel castings and drop forgings are employed throughout in its construction, thus effectually insuring it against hard usage.

NOTES

All rocks contain some water, but some, such as the granites, carry only an inappreciable amount. Sandstone, on the other hand, has an absorptive capacity of a gallon or more of water to the cubic foot of rock and is the best water bearer of the solid rocks.

More inefficient men are talking about efficiency these days than about anything else. It is beginning to seem as though a man who has proved a failure at nearly everything else, becomes an efficiency engineer.—*'Black Diamond.'*

Daylight can be seen at the portal of the Snake Creek tunnel, Park City, Utah, from the face which is in over two miles.

Ignorance can defeat all safety precautions. Two Kentucky Miners went into a cloud of powder smoke and sat down to wait for it to clear away. They died, as did three others in the same state from the same cause. A little information would have clinched "safety first" in those cases.

William Murdock lighted his house with gas from coal in 1792, he fitted up a gas making machine at Soho in 1798, and illuminated Boulton and Watts factory in 1802. Mr. Winsor established the first public gas lamps in Pall Mall about the year 1805.

Joplin district, Missouri, has a record of more than fifty years of continuous ore production, aggregating nearly $300,000,000 in value, which during the last ten years has averaged from $12,000,000 to $17,000,000 a year, and will this year exceed $20,000,000.

In a bottle factory in Cincinnati three lines of air piping are required. A vacuum of 26 in. is carried to draw the glass into the mold, air at 20 lb, gage pressure is used to blow the gas to fill the mold, and an air blast at a pressure of 5 to 6 oz. is directed upon each mold to cast it to the proper temperature for handling the glass. In the same plant also air at 200 lb. is used to start the gas engines.

More than 100 entombed miners have been saved from certain death by the life savers of the U. S. Bureau of Mines. The bureau now maintains six rescue stations in mining districts, together with eight rescue cars, which visit the various mining camps and train the men in different kinds of rescue work.

Jozsef Vig of Witherbee, New York, has patented, No. 1,131,300, a combined parachute and life preserver in which devices may be operated to cause the parachute to open automatically. In descending air is forced by the descent of the parachute through suitable passages and joints into the life preserver which latter may encircle the wearer in the usual manner so that the operator will be gradually lowered in the water and when in the water will be buoyed by the life preserver.

It is reported from South Africa that a new petrol substitute has been invented which, it is stated, can be supplied at 3¾d. per gallon, even then leaving a profit of 48 per cent. The inventor is said to be a well-known analytical chemist, who has been engaged for twelve years as chief chemist at one of the largest sugar factories near Durban. It is stated that he has devoted a great deal of attention to the question of obtaining a motor spirit from molasses, and the result of his labors is a petrol

Pneumatic Patents March 2.

substitute to be called Petrolex. A company has been formed to exploit this process, which is said to produce a motor spirit of greater efficiency than petrol.—*The Engineer*, London.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 2.

1,129,878. REGULATING DEVICE FOR MOTOR-DRIVEN COMPRESSORS. FREDERICK L. LUCKER, Brooklyn, and ALLAN O. CARPENTER, Corning, N. Y.

1,130,229. FUEL-SPRAYER. SVEN GUSTAF WICELIUS, Stockholm, Sweden.

1,130,267. HUMIDIFIER AND AIR-CLEANER. GEORGE BREWER GRIFFIN, Edgewood Park, Pa.

1,130,394. COMPRESSOR FOR GASES. HORATIO G. GILLMOR, Washington, D. C.

1,130,447. AUTOMATIC TRAIN-BRAKE-CONTROL APPARATUS. WALTER V. TURNER, Edgewood, Pa.

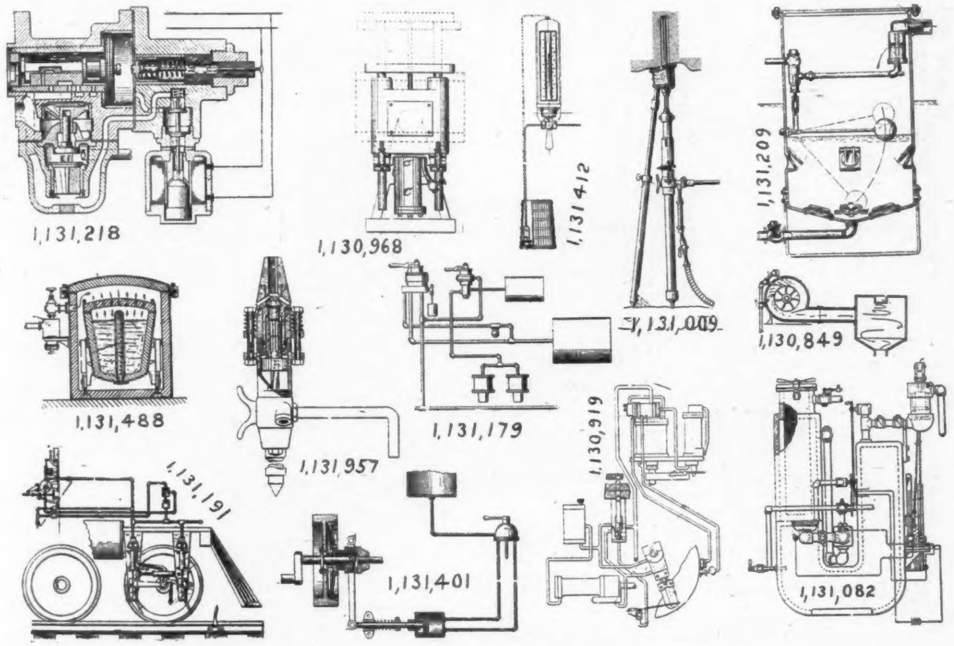
1,130,448-9-10. FLUID-PRESSURE BRAKE FOR LOCOMOTIVES. WALTER V. TURNER, Edgewood, Pa.

1,130,477. PNEUMATIC RAILWAY-SWITCH. CHARLES CHAPPELLE, Oklahoma, Okla.

1,130,518. PNEUMATIC-DESPATCH-TUBE APPARATUS. CHESTER SNOW JENNINGS, Boston, Mass.

1,130,656. PNEUMATIC SPRING FOR VEHICLES. WARREN W. ANNABLE, Grand Rapids, Mich.

1,130,679. VACUUM WORK-HOLDER. GRAY STAUNTON, Chicago, Ill.



PNEUMATIC PATENTS MARCH 9.

1,129,897. AIR-MOISTENING DEVICE. GEORGE B. OWEN, Jr., Brooklyn, N. Y.

1,130,101. PNEUMATIC DEVICE FOR MUSICAL INSTRUMENTS. MARTIN NEWCOMER, New York, N. Y.

1,130,104. PROCESS FOR THE PRODUCTION OF NITRIC ACID. FRITZ RASHIG, Ludwigshafen-on-the-Rhine, Germany.

1,130,114. VACUUM CLEANING APPARATUS. HOWARD SMALL, Wyncote, Pa.

1,130,194. OIL-BURNER. ALFRED PAPILLON, Lowry, La.

1,130,224. AIR-BRAKE SYSTEM. JOHN EUGENE WALLACE, New York, N. Y.

1. A system of valves rotated by magnetic torque into various positions for the purpose of controlling the admission and discharge of fluid pressure to and from the brake cylinders on a train of one or more cars, and put in parallel operative relation by the use of three or more train wires in which electric curent shall flow in a given direction.

MARCH 9.

1,130,827. APPARATUS FOR GENERATING OZONE. WILLIAM JOHN KNOX, New York, N. Y.

1,130,849. AIR COOLING AND FILTERING DEVICE. JAMES M. SEYMOUR, Jr., Newark, N. J.

1,130,884. PNEUMATIC JACK FOR MOTORCARS. EDWARD B. BLAKEY and RUFUS B. MCCOLLUM, Kansas City, Mo.

1,130,918-9-90. APPARATUS FOR PRESSING GLASS ARTICLES. WILLIAM J. MILLER, Swissvale, Pa.

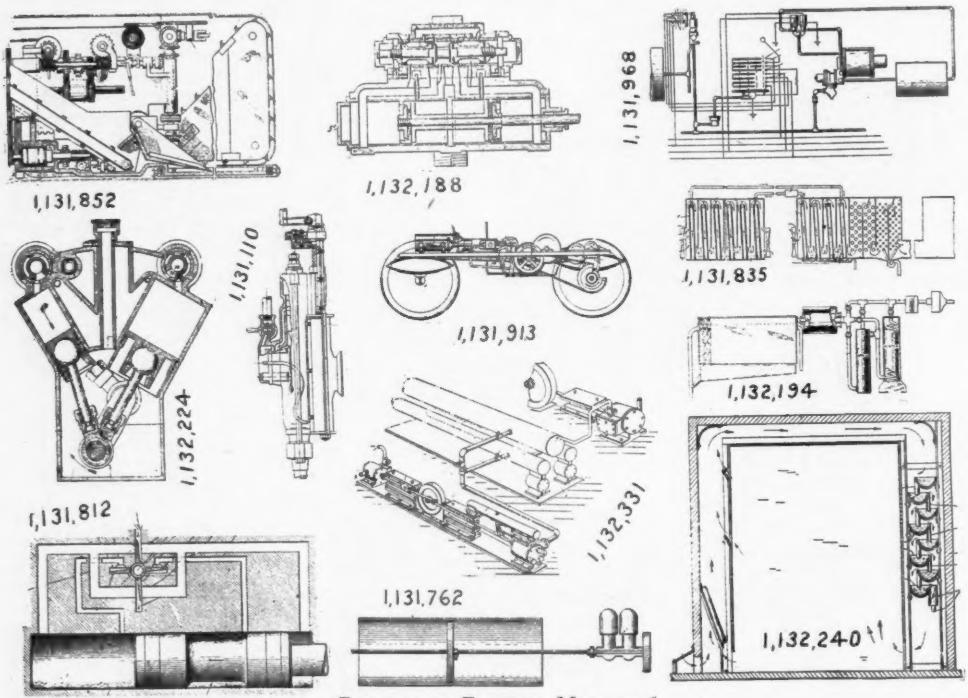
1,130,940. PROCESS FOR THE SYNTHESIS OF GASES. LELAND L. SUMMERS, Chicago, Ill.

1,130,957. FRONT-HEAD CONSTRUCTION FOR SELF-ROTATING HAMMER-DRILLS. LEWIS C. BAYLES, Easton, Pa.

1,130,968. MOLDING-MACHINE. GEORGE L. GRIMES, Detroit, Mich.

1,131,009. DUST-COLLECTOR FOR ROCK-DRILLS. FRANK RYLANDER, Dumont, Colo.
1,131,052. DUST-COLLECTOR FOR ROCK-DRILLS. EMMET F. GALLIGAN, Idaho Springs, Colo.
1,131,082. VACUUM-PRODUCING APPARATUS. JOHN PRIEST, Philadelphia, Pa.
1,131,178-9-80. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.
1,131,191. AUTOMATIC TRAIN-CONTROLLING DEVICE. LOUIS C. WERNER, Webster, Mass.
1,131,209. LIQUID-ELEVATING APPARATUS. EDWIN CHAMBERLIN and ANDREW M. GARDNER, Avella, Pa.
1,131,218-9. ELECTRICALLY-CONTROLLED BRAKE MECHANISM. EDWARD H. DEWSON, New York, N. Y., and WALTER V. TURNER, Edgewood, Pa.

tion of the first spring, and fluid pressure actuated means for nullifying the effect of the second spring.
1,131,412. PNEUMATIC DEPTH-INDICATOR. HARRY S. PARKS, Philadelphia, Pa.
1,131,420. AIR-CONTROLLING VALVE. HARRY L. RIDER, Oil City, Pa.
1,131,488. VACUUM PROCESS FOR PRODUCTION OF STEEL. EUGEN DOLENSKY, Frankfort-on-the-Main, Germany.
1. A process for purifying metals consisting in heating a clearing vessel to the temperature approximately of the molten metal to be purified, placing the molten metal therein and subjecting same to the action of a vacuum, substantially as and for the purpose described.
1,131,554. BLOWER. THEODORE JONATHAN RITTER, New York, N. Y.



PNEUMATIC PATENTS MARCH 16.

1,131,309. MANUFACTURE OF GASOLENE. RAYMOND F. BACON, BENJAMIN T. BROOKS, and CLINTON W. CLARK, Pittsburgh, Pa.
1. The method of producing from petroleum oils which have a boiling point of 250° C. and upward, a mixture of hydrocarbons boiling below 200° C., which consists in subjecting the petroleum oils treated to a combined cracking and distilling operation at a temperature within the range of 350° C. to 500° C., and at a pressure within the range of 60 lbs. to 300 lbs. per square inch, progressively removing from the heating zone the particles of tar and coke produced therein and depositing them out of contact with the walls of said heating zone; substantially as described.
1,131,391. PNEUMATIC-MOTOR FOR PIANO-PLAYERS. JOSEPH LEISCH, Tryon, N. C.
1,131,401. CLUTCH MECHANISM. JOHN G. MACPHERSON, Philadelphia, Pa.
3. The combination of a clutch having relatively movable engaging members, a spring normally tending to force said members into engagement, a second and stronger spring opposing the ac-

1,131,577. AIR-COMPRESSOR. CHARLES WAINWRIGHT, Erie, Pa.

MARCH 16.

1,131,762. AIR-PROPELLER. WILLIAM N. WHIPPLE, Syracuse, N. Y.
1,131,812. VALVE-MOTION FOR PNEUMATIC TOOLS. ROBERT LUNNAN AMBROSE, Easton, Pa.
1,131,835. APPARATUS FOR DEHYDRATING AND WARMING AIR. GORDON DON HARRIS, Bay Shore, N. Y., and JAMES S. POLLARD, Bayonne, N. J.
1,131,852. PNEUMATIC SYSTEM OF MINING COAL AND REMOVING FOUL GASES FROM MINE-CHAMBERS. EDMUND C. MORGAN, Chicago, Ill.
1. The combination with a mining machine, of a pneumatic flue extending from said mining machine, and means for automatically lengthening said flue continuously as the said mining machine moves forward and in accordance with such forward movement.

1,131,913. COMPRESSOR-AIR MOTOR-MACHINE. CHARLES COOPER, Kansas City, Mo.

1,131900-67-71. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,131,994. EXPLOSIVE CONTAINING LIQUID AIR OR OXYGEN AND LAMPBLACK. GEORGES CLAUDE, Paris, France.

1. An explosive cartridge comprising liquid air or oxygen, and lamp black having a density of about 0.23 to 0.26 permeated by said liquid.

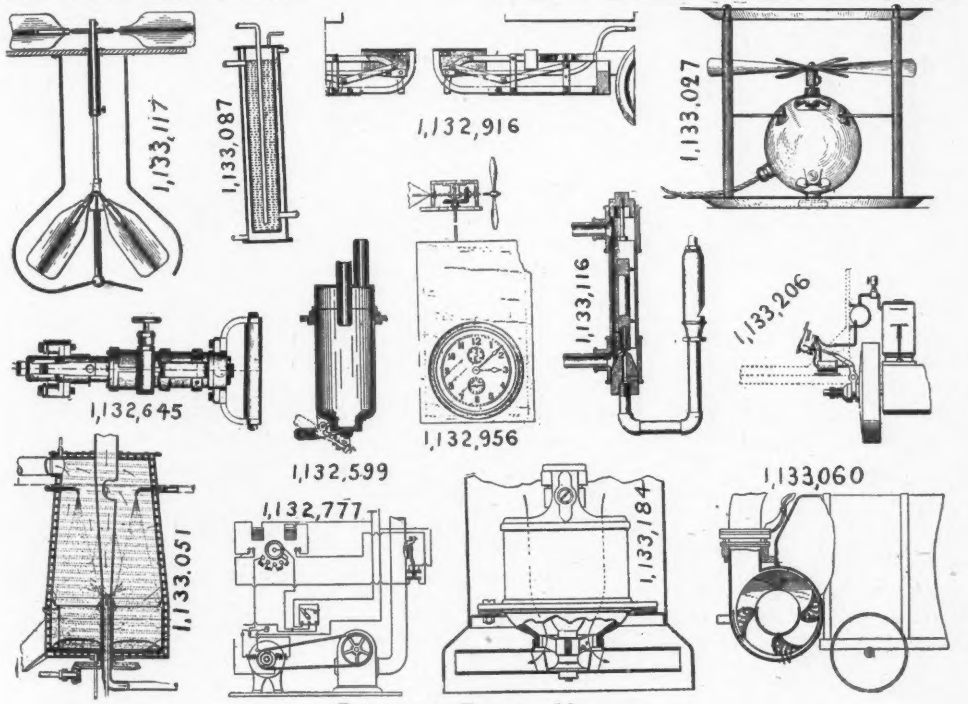
2. An explosive cartridge comprising a mixture of lamp black having a density of about 0.23 to 0.26 and napthalene, and liquid air or oxygen permeating said mixture.

1,132,246. AIR-CONDITIONING SYSTEM. LOUIS M. DU COMMUN, Cleveland, Ohio.

1,132,276. ROCK-DRILL. VILHELM P. KESSEL, San Francisco, Cal.

1,132,331. AIR-COMPRESSING APPARATUS. WILLIAM CHARLES GEBHARDT, San Antonio, Tex.

1. An air compressing and air storing apparatus, comprising a low pressure container provided with means for connecting it with apparatus to be driven, a high pressure container, an engine driven by compressed air from the high pressure container, a compressor drawing air from the atmosphere operated by said engine and



PNEUMATIC PATENTS MARCH 23.

3. An explosive cartridge comprising a mixture of lamp black having a density of 0.23 to 0.26 and napthalene constituting from 5 per cent. to 25 per cent. of the mixture, and liquid air or oxygen permeating said mixture.

1,132,110. AUTOMATIC WORK-REGISTER. GEORGE R. MURRAY, Cleveland, Ohio.

1. A register of the class described, comprising counting means, and operating means therefor arranged to be operated by a movable member of a fluid-pressure-actuated machine to which the register is applied, such operating means comprising fluid-pressure-controlled power-transmitting means adapted to be connected to the source of supply of fluid pressure for such tool or machine, and arranged to disconnect the counter from such operating means during idle periods.

1,132,188. FLUID-MOTOR. HUGH W. KIMES, Dayton, Ohio.

1,132,194. APPARATUS FOR DEHYDRATING OR DESICCATING AIR FOR INDUSTRIAL PURPOSES. FRANCISCO GARCIA P. LEAO, New York, N. Y.

1,132,224. STARTER FOR INTERNAL-COMBUSTION ENGINES. GREGORY JOHN SPOHRER, East Orange, N. J.

1,132,237. COMBINATION-BLOWER. HAROLD A. BIERCK, Philadelphia, Pa.

compressing air into the low pressure container, and a compounder operated by said engine for forcing air under increased pressure into the high pressure container.

MARCH 23.

1,132,599. MILKING-MACHINE. ERNEST L. MILLS, Watertown, and RICHARD M. MILLS, Cicero, N. Y.

1,132,649. PNEUMATIC TOOL. BENJAMIN BRAZELLE, St. Louis, Mo.

1,132,650. VENT-REGULATOR FOR PNEUMATIC ACTIONS. MELVILLE CLARK, Chicago, Ill.

1,132,777. AUTOMATIC PRESSURE-CONTROLLER. CHESTER S. JENNINGS, Brookline, Mass.

1,132,916. AUTOMATIC BRAKE-PIPE COUPLING. DESIRE DORSO, Vancouver, British Columbia, Canada.

1,132,956. DEVICE FOR UTILIZING WIND-POWER. PAUL MEDVED, Milwaukee, Wis.

1,133,027. VENTILATING APPARATUS AND METHOD. PETER COOPER HEWITT, New York, N. Y.

1,133,051. METHOD OF DESICCATING. IRVING S. MERRELL, Syracuse, N. Y.

1. The method of desiccating organic liquids containing a high moisture content which consists in spraying the liquid into a chamber in which a high degree of vacuum is maintained, injecting into said chamber highly superheated steam, the temperature of the steam being sufficiently high so that it will not condense within the chamber at the minus pressure maintained therein, and preventing condensation within the chamber by heating the walls thereof.

1,133,060. PNEUMATIC STACKER. VICTOR NELSON PERRY, Batavia, N. Y.

1,133,087. PURIFICATION OF HYDROGEN. CARL BOSCH and WILHELM WILD, Ludwigshafen-on-the-Rhine, Germany.

1,133,116. AIR-SIGNAL VALVE. EDWARL JOSEPH ERICSSON, San Francisco, Cal.

pressure thereto to cause the high pressure blasts therefrom to penetrate the bath.

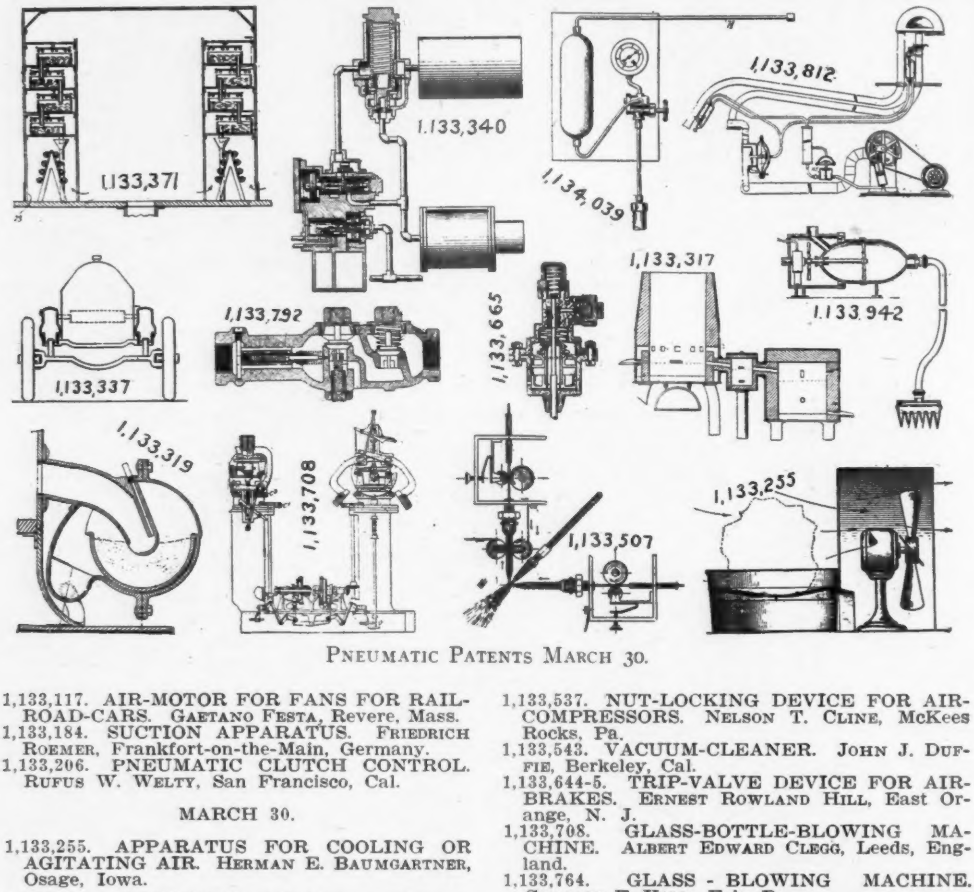
1,133,319. COMBINED GRAVITY AND FLUID-PRESSURE SANDER FOR LOCOMOTIVES. EDWIN A. RIVES and HARRISON B. NABORS, Greensboro, N. C.

1,133,337. PNEUMATIC-CUSHIONED FRAME SUSPENSION. GUY L. TINKHAM, Paris, France.

1,133,340-1. FLUID-PRESSURE BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,133,371. AIR-CONDITIONING SYSTEM. LOUIS M. DU COMMUN, Cleveland, Ohio.

1,133,507-8. APPARATUS FOR SPRAYING MOLTEN METAL AND OTHER FUSIBLE SUBSTANCE. MAX ULRICH SCHOOP, Zurich, Switzerland.



PNEUMATIC PATENTS MARCH 30.

1,133,117. AIR-MOTOR FOR FANS FOR RAILROAD-CARS. GAETANO FESTA, Revere, Mass.

1,133,184. SUCTION APPARATUS. FRIEDRICH ROEMER, Frankfort-on-the-Main, Germany.

1,133,206. PNEUMATIC CLUTCH CONTROL. RUFUS W. WELTY, San Francisco, Cal.

MARCH 30.

1,133,255. APPARATUS FOR COOLING OR AGITATING AIR. HERMAN E. BAUMGARTNER, Osage, Iowa.

1,133,257. PNEUMATIC ACTION. GEORGE P. BRAND, New York, N. Y.

1,133,269. PRESSURE-ALARM FOR PNEUMATIC TIRES. GEORGE A. CULVER, Beatrice, Neb.

1,133,317. METALLURGICAL APPARATUS. CHARLES J. RICE, Ashland, Ky.

1. A cupola furnace adapted to contain a bath of molten metal, main twyers arranged therein above the bath of metal, means for supplying air at relatively low pressure thereto, and high pressure purifying twyers fitted in the furnace below the main twyers and above the level of the top of such bath and inclined downwardly and having means for suplying air at relatively high

1,133,537. NUT-LOCKING DEVICE FOR AIR-COMPRESSORS. NELSON T. CLINE, McKees Rocks, Pa.

1,133,543. VACUUM-CLEANER. JOHN J. DUFFIE, Berkeley, Cal.

1,133,644-5. TRIP-VALVE DEVICE FOR AIR-BRAKES. ERNEST ROWLAND HILL, East Orange, N. J.

1,133,708. GLASS-BOTTLE-BLOWING MACHINE. ALBERT EDWARD CLEGG, Leeds, England.

1,133,764. GLASS - BLOWING MACHINE. CHARLES E. VOLK, Erie, Pa.

1,133,792. UNLOADING DEVICE FOR COMPRESSORS. HERBERT W. CHENEY, Milwaukee, Wis.

1,133,793. PNEUMATIC PIANO-ACTION. ROBERT W. COOPER, Dayton, Ky., and FRANK A. LEE and RAY J. MEYER, Cincinnati, Ohio.

1,133,812. PNEUMATIC-DESPATCH-TUBE APPARATUS. JAMES G. MACLAREN, Harrison, N. Y.

1,133,942. BARBER'S DEVICE. ANTONIO DI SALVIO, Washington, Pa.

1,134,039. TORPEDO-TESTING APPARATUS. WILLIAM DIETER, Brooklyn, N. Y.

1,134,070. SEALING-MACHINE. ROBERT MAGRANE, New York, N. Y.